



Mapping and Assessment of Key Vegetation Communities Across the Ku-ring-gai Local Government Area

Volume 2: Vegetation Communities

July 2010



Contents

1	Vegetation Community Profiles	3
	BLUE GUM HIGH FOREST	5
	Blue Gum High Forest (complex) - BGHFC	5
	BGHF (typical form) - BGHFT	5
	BGHF (dry form) - BGHFD	5
	BGHF (sandstone gully form) – BGHFS	5
	SYDNEY TURPENTINE - IRONBARK FOREST	14
	Sydney Turpentine - Ironbark Forest (complex) – STIFC	14
	STIF (typical form) – STIFT	14
	STIF (dry transition form) – STIFD	14
	STIF (wet transition form) – STIFW	14
	COASTAL SHALE SANDSTONE FOREST	24
	Coastal Shale Sandstone Forest (complex) – CSSFC	24
	Coastal Shale Sandstone Forest (taller forest form) – CSSFT	24
	Coastal Shale Sandstone Forest (low forest/woodland form) – CSSFF	24
	DUFFYS FOREST	31
	Duffys Forest (complex) – DFC	31
	Duffys Forest (typical form) – DFTY	31
	Duffys Forest (transition form) – DFT	31
	SYDNEY SANDSTONE RIDGETOP WOODLAND	38
	Sydney Sandstone RidgeTop Woodland – SSRW	38
	Sydney Sandstone Ridgetop Woodland (clay influence) – SRWCL	38
	Sydney Sandstone Ridgetop Woodland (wet heath) – SSRWH	38
	SYDNEY SANDSTONE GULLY FOREST	41
	Sydney Sandstone Gully Forest – SSGF	41
	Sydney Sandstone Gully Forest (clay influence) – SSGFCL	41
	GULLY RAINFOREST	45
	Gully Rainforest - GRF	45
	SALINE WETLANDS	47
	Saline Wetlands	47
	FORESTED WETLANDS	49
	Forested Wetlands	49
2	Key to the identification of ecological communities in Ku-ring-gai LGA	51
3	Ku-ring-gai LGA – vegetation communities and relationships with geology, soils and landscape features	58

1 Vegetation Community Profiles

Vegetation profiles are based on both field survey data and Sydney Metropolitan Vegetation mapping (DECCW 2009a). Profiles describe all vegetation communities within the Ku-ring-gai Local Government Area for:

- Key vegetation communities mapped within this project
- Key and Non key vegetation communities broadly mapped within this project and informed by regional DECCW 2009 mapping.

Profiles are specific to the Ku-ring-gai LGA and include a description of key identifying features (e.g. geology, altitude and soil landscape), LGA examples, significance and indicative species lists. This list does not represent all species identified within any given location or community. For key communities this list has been drawn from field survey data (rapid survey proformas and plot information from this project and DECCW 2009a).

Methods used to derive these vegetation communities and references cited within this document, are outlined within *Volume 1: Technical Report of Mapping and assessment of key vegetation communities across the Ku-ring-gai Local Government Area (KMC 2009)*.

EXPLAINTION OF PROFILES:

VEGETATION COMMUNITY

Vegetation community names

MAPPING CODE

Image of sampled site

mapped distribution of vegetation community

Description

The description provides an overview of community characteristics and explains community vegetation community complexes and forms (as outlined within Volume 1, Section 5.2).

Table 1: Area (ha) of sample vegetation community with various condition classes within Ku-ring-gai LGA

Community	A	B	TXND / TXN	TXUD / TXU	CMI / R
Community name	20 ha	2 ha	3 ha	1 ha	

Table 2: Mapped areas (ha) of sample vegetation community (complex) and forms within Ku-ring-gai with reference to condition

Condition Class	A / B	TXND / TXN	TXUD / TXU	CMI / R
Community name (complex)	3 ha	-	-	-
Community name (form)	19 ha	3 ha	1 ha	-

Threats

Key threats identified as impact upon the community are outlined, as recorded within the Ku-ring-gai Local Government Area.

Conservation Status

This section describes the vegetation communities:

- Protection status under is threatened under the *Threatened Species Conservation Act 1995*, the *Environment Protection and Biodiversity Conservation Act 1999*, or
- Regional significance

Table 3: Conservation status of sample vegetation community (*complex*) and forms within Ku-ring-gai

	Vegetation community	Area within Ku-ring-gai (ha) (excluding DECCW lands)				
		A / B	TXND / TXN	TXUD / TXU	CMI / R	TOTAL
Council natural area	Community name (<i>complex</i>)	26 ha				
	Community name (<i>form</i>)					
TOTAL						
Other council managed lands	Community name (<i>complex</i>)	5 ha				
	Community name (<i>form</i>)					
TOTAL						
Other lands (excluding DECCW estate)	Community name (<i>complex</i>)					
	Community name (<i>form</i>)					
TOTAL						
Total extant area						

Conservation status (Table 3) for draft vegetation mapping (KMC 2009) has been derived from:

- Intersecting KMC vegetation mapping with a reservation layer consisting of all Council's managed lands (2009) and DECCW estate (DECCW 2008), with results separated into the area of vegetation within council natural areas, area within other council managed lands and the area of other lands (excluding DECCW estate).
- The figure in grey indicates the area mapped as highly and very highly disturbed areas, including: dense urban vegetation (TXUD), scattered urban vegetation (TXU), non native canopy potential regeneration (Cmi) and regeneration (R). This category incorporates areas where disturbances have severely reduced the ecological integrity of the patch and its potential to recover, without significant assistance.
- The figure in black indicates all remaining combinations of condition, including those areas 'not assessed' for these attributes.
- The percent of extant area in formal conservation reserves has been calculated using the area in formal conservation reserves and the total extant area for all condition classes **except** those which are very highly disturbed as described above.

Relationship to Other Communities

This section outlines relationships between the vegetation community and other vegetation communities identified within the Ku-ring-gai LGA.

Relationship to Other Mapping

The vegetation communities' relationship to state-wide, regional and other existing mapping products are outlined.

Species Richness

Results from plot analysis undertaken (Volume 1, Section 4.6), are provided as well as the most frequently recorded species for the community within Ku-ring-gai.

BLUE GUM HIGH FOREST

Blue Gum High Forest (<i>complex</i>)	BGHFC
BGHF (<i>typical form</i>)	BGHFT
BGHF (<i>dry form</i>)	BGHFD
BGHF (<i>sandstone gully form</i>)	BGHFS



Description

Blue Gum High Forest (BGHF) is a tall wet sclerophyll forest found on deeper, fertile shale soils in the high rainfall districts of northern Sydney (900 mm to 1300 mm mean annual rainfall) at altitudes mostly of 80 to 200 m above sea level but recorded as low as 30 m. The main occurrence of this community is across the ridgelines between Castle Hill and St Ives with small areas found in Ryde, Lane Cove and Willoughby where it is found at lower elevations. The largest area of remaining Blue Gum High Forest is found within the Ku-ring-gai LGA, predominantly along the Pacific Highway between Pymble and Wahroonga. To the north of the highway within this area undulating topography supports BGFH for a distance of approximately 2 km compared to approximately 1 km to the south due to steeper slopes and the close proximity of sandstone gullies.

Relative proportions of the various condition classes are shown in Table 4.

Table 4: Area (ha) of Blue Gum High Forest (all forms) with various condition classes within Ku-ring-gai LGA

Community	A	B	TXND / TXN	TXUD / TXU	CMI / R
Blue Gum High Forest	19.24	1.18	17.06	231.36	2.48

Blue Gum High Forest within Ku-ring-gai is dominated by tall trees of Sydney Blue Gum (*Eucalyptus saligna*) and Blackbutt (*Eucalyptus pilularis*). Smaller trees and shrubs, comprising both sclerophyllous and mesophyllous species, form a sparse to open cover above a ground layer of mesic grasses, herbs and often ferns and vines. Blue Gum High Forest is typically associated with ridgelines, slopes and small gully heads where deep shale soils may accumulate as a result of down-slope movement.

Three forms of Blue Gum High Forest are identified within the LGA:

- **typical form** occurring on sheltered slopes
- **dry form** in more exposed sites associated with ridges
- **sandstone gully form** where some sandstone influence is evident.

Together they form a Blue Gum High Forest (**Complex**). The three forms are described in detail below and have been mapped separately although in some areas prior to the identification of Blue Gum High Forest forms and within locations where the forms inter-grade over short distances the forest is mapped as Blue Gum High Forest (*complex*). Relative proportions of the three forms are shown in Table 5.

Table 5: Mapped areas (ha) of Blue Gum High Forest (*complex*) and forms within Ku-ring-gai with reference to condition

Condition Class	A / B	TXND / TXN	TXUD / TXU	CMI / R
Blue Gum High Forest (<i>complex</i>)	13.80	4.66	102.21	1.77
BGHF (typical form)	0.79	5.94	50.80	0.36
BGHF (<i>dry form</i>)	3.65	2.52	39.65	0.16
BGHF (<i>sandstone gully form</i>)	2.18	3.95	38.71	0.19

Threats

The primary threats to this community occur along the ridgelines, through clearing for residential, and commercial redevelopment with the key centres and along main transport routes. Down-slope the main threats are small-scale residential clearing, nutrient enrichment, garden escapes and weed invasion.

Conservation Status

Blue Gum High Forest is listed as a Critically Endangered Ecological Community under Schedule 1 of the NSW *Threatened Species Conservation Act 1995*. Blue Gum High Forest in the Sydney Basin Bioregion is also listed as Critically Endangered Ecological Community under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Table 6: Conservation status of Blue Gum High Forest (*complex*) and forms within Ku-ring-gai

	Vegetation community	Area within Ku-ring-gai (ha) (excluding DECCW lands)				
		A / B	TXND / TXN	TXUD / TXU	CMI / R	TOTAL
Council natural area	Blue Gum High Forest (<i>complex</i>)	10.64	0.08	2.74	0.02	13.48
	BGHF (typical form)	0.03	1.62	0.57	-	2.22
	BGHF (<i>dry form</i>)	1.52	0.11	0.73	-	2.36
	BGHF (<i>sandstone gully form</i>)	1.21	1.56	4.76	-	7.52
TOTAL		13.39	3.37	8.80	0.02	25.57
Other council managed lands	Blue Gum High Forest (<i>complex</i>)	0.06	0.42	3.12	0.05	3.64
	BGHF (typical form)	0.47	1.35	0.89	-	2.70

	BGHF (<i>dry form</i>)	0.04	0.44	1.63	0.01	2.11
	BGHF (<i>sandstone gully form</i>)	0.54	-	2.10	0.03	2.67
TOTAL		1.10	2.21	7.74	0.08	11.13
Other lands (excluding DECCW estate)	Blue Gum High Forest (<i>complex</i>)	3.10	4.16	96.35	1.70	105.31
	BGHF (<i>typical form</i>)	0.30	2.97	49.34	0.36	52.97
	BGHF (<i>dry form</i>)	2.09	1.96	37.30	0.16	41.51
	BGHF (<i>sandstone gully form</i>)	0.44	2.39	31.84	0.16	34.83
TOTAL		5.93	11.48	214.83	2.38	234.62
Total extant area		20.42	17.06	231.36	2.48	271.33

The drier and typical forms are most at risk from clearing, located primarily outside of conservation area these forms are the most in need of protection. The sandstone gully form of BGHF although better reserved requires extensive bush regeneration and weed control or rehabilitation.

Relationship to Other Communities

Blue Gum High Forest is closely related to Sydney Turpentine-Ironbark Forest (STIF) and together these communities represent a unique tall eucalypt forest assemblage on shale soils in the Bioregion. Within Ku-ring-gai LGA, BGHF grades into STIF where the depth of shale decreases near or at the sandstone boundary and to a lesser extent with decreasing rainfall.

Relationship to Other Mapping

Blue Gum High Forest fits within the:

- statewide class *North Coast Wet Sclerophyll Forests* (Keith 2004)
- Property Vegetation Plan (PVP) biometric vegetation type is *Sydney Blue Gum – Blackbutt – Smooth-barked Apple moist shrubby open forest on shale ridges of the Hornsby Plateau, Sydney Basin* (DECCW 2009)
- Sydney Metropolitan Catchment Management Authority (SMCMA) Area mapping unit Blue Gum High Forest (S_WSF01 p46) (DECCW 2009)
- Blue Gum High Forest (WSF p153) regional map unit (Tozer *et al* 2006).

Blue Gums occurring in deeper soils along larger creek-lines within a sandstone environment i.e. with sandstone gully forest on either side, are part of Coastal Enriched Sandstone Moist Forest (S_WSF02) of DECCW (2009a) and are not included in the BGHF CEEC.

Species Richness

Plots (20 m x 20 m) generally contain between 40 and 50 native species with the % of indicator shale species up to 65-70% for BGHF (*dry form*) and between 40 and 50% where there is a gully influence (BGHF **sandstone gully form**).

The most frequently recorded species in Ku-ring-gai remnants of Blue Gum High Forest generally (all forms):

Eucalyptus saligna, *E. pilularis*, *Pittosporum undulatum*, *Cyperus gracilis*, *Dichondra repens*, *Lomandra longifolia*, *Microlaena stipoides*, *Oplismenus aemulus*

Geology: Ashfield Shale of the Wianamatta Group (predominantly siltstone), up to 60 metres deep in northern part of LGA e.g. Wahroonga.

Altitude: Mostly 90 m to 190 m above sea level. Below 90 m patches rare & confined to very sheltered sites associated with drainage lines.

Soil landscape & characteristics: Predominantly Glenorie (Gn), smaller areas of West Pennant Hills and occasionally Lucas Heights at lower altitudes (close to boundary with shale). Soil a deep, dark brown to brown, clay to clay loam.

Habitat: Steeper side slopes of the central plateau and lateral ridgelines, particularly south and east-facing; shallow depressions/concave slopes associated with drainage lines on upper to mid slopes (away from direct sandstone influence in deeper gullies). Typically found down-slope of drier form of BGHF or STIF.

Distribution: Across the LGA but main occurrence between Mona Vale Road and Wahroonga. Examples of most intact areas - south of Fox Valley Road & Pacific Highway (Warrawee); south of Pacific Highway in Pymble-Turramurra district; both sides of the Pacific Highway in the Lindfield-Killara district (lower altitudes). Areas are typically small due to frequent intergrading with gully form in the vicinity of gully heads.

Vegetation structure: Tall open forest with mesic understorey, typically with few or scattered shrubs due to disturbance and mowing regimes.

Species recorded in Ku-ring-gai are listed below. *Species underlined are characteristic species as listed in the Final Determination and those in bold are diagnostic species of DECCW (2009a).

Canopy trees: *Eucalyptus pilulari*, *Eucalyptus saligna*

Smaller trees: *Pittosporum undulatum*, *Allocasuarina torulosa*, *Acmena smithii* *Brachychiton acerifolius* (but often naturalized), *Acacia parramattensis*, *Exocarpos cupressiformis*.

Shrubs: *Breynia oblongifolia*, *Polyscias sambucifolia*, *Notelaea longifolia*, *Pittosporum revolutum*, *Clerodendrum tomentosum*, *Platylobium formosum*, *Homalanthus populifolius*, *Maytenus silvestris*, *Acacia longissima*.

Ground layer-graminoids: *Entolasia marginata*, *Poa affinis*, *Microlaena stipoides*, *Oplismenus aemulus*, *Oplismenus imbecillus*, *Lomandra longifolia*, *Cyperus gracilis*, *Carex inversa*, *Dichelachne micrantha*, *Austrodanthonia racemosa*.

Ground layer-ferns & herbs: *Adiantum aethiopicum*, *Calochlaena dubia*, *Blechnum cartilagineum*, *Pseuderanthemum variabile*, *Dichondra repens*, *Centella asiatica*, *Siegesbeckia orientalis*, *Dianella caerulea*, *Oxalis perennans*, *Oxalis exilis*, *Geranium homeanum*, *Rumex brownii*, *Veronica plebeia*, *Pratia purpurascens*, *Wahlenbergia gracilis*, *Einadia trigonos*.

Climbers: *Commelina cyanea*, *Eustrephus latifolius*, *Pandorea pandorana*, *Cayratia clematidea*, *Smilax glyciophylla*, *Clematis glycinoides*, *Glycine microphylla*, *Cissus antarctica*.

Most frequent species recorded in Ku-ring-gai mapping project:

Eucalyptus saligna, *E. pilularis*, *Pittosporum undulatum*, *Austrodanthonia racemosa*, *Carex inversa*, *Cyperus gracilis*, *Dichondra repens*, *Glycine microphylla*, *Lomandra longifolia*, *Microlaena stipoides*, *Oplismenus aemulus*.

Threat level: Critically endangered. Habitat preferred for development - upper slopes below ridgelines along the Pacific Highway e.g. Gordon, Turramurra, Lindfield. Often occurs in narrow strips in backyards or drainage easements at back of houses (close to ridge-line). The most rare and endangered of the BGHF forms.

Examples: Upper part of Clive Evatt Reserve (Figure 1a) (intergrades into gully form), reserve adjacent to Turramurra Plaza, Glade Reserve at Wahroonga (upper parts), North Pymble Park (Figure 1b).

Notes: Consistent with DECCW (2009a) classification of BGHF and Final Determination. Common species within Ku-ring-gai not listed in Final Determination occur predominantly in the ground layer: *Microlaena stipoides*, *Cyperus gracilis*, *Centella asiatica*, *Dichondra repens*, *Geranium homeanum*, *Rumex brownii* &

Glycine microphylla. These are the species most frequently persisting within fragmented remnants in private yards and along road reserves and are important indicators of the community.

Mapping: Some areas may be mapped within the broader classification of Blue Gum High Forest (*complex*).



Figure 1a **Blue Gum High Forest (typical form)**
Clive Evatt Reserve



Figure 1b **Blue Gum High Forest (typical form)**
North Pymble Park

Geology: Ashfield Shale. Typically includes more coarse soil with fine sandstone laminae and ironstone nodules resulting from deep lateritic weathering.

Altitude: Mostly 130 m to 200 m above sea level but down to 90 m - 120 m in central and southern parts of the LGA e.g. suburbs of Gordon, Lindfield, Killara and West Pymble.

Soil landscape & characteristics: Mostly Glenorie (Gn), occasionally Lucas Heights at lower altitudes (close to shale boundary). Soil medium to shallow depth, brown to orange-brown, silty to sandy clay-loam with a medium to high clay content. Occasionally some sandstone fragments (from sandstone laminae within shale) or more frequently lateritic gravels exposed.

Habitat: Higher ridgelines, crests and benches/spurs often with a northerly or western aspect.

Distribution: Core area in higher parts of northern LGA both north & south of the Pacific Highway & Fox Valley Road (e.g. Turramurra, Warrawee, Wahroonga). Smaller occurrences are found along Pacific Highway further south (e.g. Gordon, Killara, Lindfield), west of Ryde Road at West Pymble and along Mona Vale road south of St. Ives.

Vegetation structure & composition: Tall to medium open forest. Sydney Blue Gum is a common canopy species in association with a range of other eucalypt species; understorey drier than *typical form* generally with few or scattered shrubs due to disturbance and mowing regimes.

Species recorded in Ku-ring-gai are listed below. *Species underlined are characteristic as listed in Final Determination and those in bold are diagnostic species of DECCW (2009a).

Canopy trees: *Eucalyptus saligna*, *Eucalyptus pilularis*, *Eucalyptus paniculata*, *Angophora floribunda*, *Angophora costata*, *Eucalyptus resinifera*, *Eucalyptus acmenoides* (rare), ***Syncarpia glomulifera*** (rare).

Smaller trees: *Pittosporum undulatum*, *Acacia implexa*, *A. floribunda*, *Allocasuarina torulosa*, *Elaeocarpus reticulatus*, *Exocarpos cupressiformis*, *Brachychiton acerifolius*.

Shrubs: *Breynia oblongifolia*, *Polyscias sambucifolia*, *Notelaea longifolia*, *Pittosporum revolutum*, *Platylobium formosum*, *Indigofera australis*, *Zieria smithii*, *Acacia falcata*, *Bursaria spinosa*, *Dodonaea triquetra*, ***Leucopogon juniperinus***, *Ozothamnus diosmifolius*, *Acacia binervata*.

Ground layer-graminoids: *Entolasia marginata*, *E. stricta*, *Microlaena stipoides*, *Oplismenus aemulus*, *O. imbecillus*, *Austrodanthonia racemosa*, *A. tenuior*, *Austrostipa rudis*, *Dichelachne micrantha*, ***Echinopogon ovatus***, *E. caespitosus*, *Themeda australis*, *Cymbopogon refractus*, *Lomandra longifolia*, *L. filiformis*, *Cyperus gracilis*, *Carex inversa*

Ground layer-ferns & herbs: *Calochlaena dubia*, *Pteridium esculentum*, *Pseuderanthemum variable*, *Dichondra repens*, *Centella asiatica*, *Caesia parviflora*, *Brunoniella australis*, *Arthropodium milleflorum*, *Dianella caerulea*, *Oxalis perennans*, *Geranium homeanum*, *Desmodium varians*, *Poranthera microphylla*, ***Veronica plebeia***, *Rumex brownii*, *Einaidia trigonos*, *Wahlenbergia gracilis*, *Plantago debilis*, ***Pratia purpurascens***.

Climbers: *Hardenbergia violacea*, ***Glycine microphylla***, *G. tabacina*, *G. clandestina*, *Eustrephus latifolius*, *Commelina cyanea*, ***Cayratia clematidea***, ***Clematis glycinoides***.

Most frequent species recorded in Ku-ring-gai mapping project:

Eucalyptus saligna, *E. pilularis*, *Angophora floribunda*, *Angophora costata*, *Eucalyptus paniculata*, *Pittosporum undulatum*, *Austrodanthonia racemosa*, *Carex inversa*, *Centella asiatica*, *Cyperus gracilis*, *Dichondra repens*, *Eustrephus latifolius*, *Geranium homeanum*, *Glycine microphylla*, *Hardenbergia violacea*, *Lomandra longifolia*, *Microlaena stipoides*, *Oplismenus aemulus*, *Pratia purpurascens*, *Pteridium esculentum*, *Rumex brownii*, *Veronica plebeia*.

Threat level: This is the rarest form of BGHF, occurring within higher exposed sites, preferred for development.

Examples: Sir William Lewis Park, Exeter Road (Plot BGHFDRY02), Eastbourne Avenue, Wahroonga (Figure 2a), Warrawee Park (Borambil Street), Road reserve 1-3 Marshall Avenue, Warrawee (TJ157), upper parts of

Dalrymple Hay Nature Reserve (Figure 2b), Killara railway station car park.

Notes: Floristically similar to STIF but occurs as localized patches within BGHF areas, groundcover species typical of BGHF also present, distant from shale/sandstone boundary and generally at higher altitudes. Consistent with the DECCW (2009a) BGHF classification; similar vegetation documented outside the LGA at Darvall Park, Ryde and West Pennant Hills. *Lower consistency with Final Determination for BGHF in relation to undertorey species.

Mapping: This form of BGHF has been extensively inspected in the field; however, a couple of smaller patches may still be mapped as BGHF (*complex* or *typical form*) or STIF (*complex* or *forms*).



Figure 2a Blue Gum High Forest (*dry form*)
Eastbourne Avenue, Wahroonga



Figure 2b Blue Gum High Forest (*dry form*)
Dalrymple-Hay Nature Reserve
(upper section)

Geology: Ashfield Shale with Hawkesbury sandstone influence.

Altitude: Mostly 80 m to 190 m above sea level.

Soil landscape & characteristics: Mostly Glenorie (Gn), also Gynea and Lucas Heights. Soil of variable depth, dark brown to brown, sandy clay loam – some sandstone fragments or minor outcrops may be present. Shale soils moved down-slope may lie above sandstone bedrock along drainage lines.

Habitat: Lower to mid-slopes of shallow depressions or elevated gullies in higher parts of landscape.

Vegetation structure & composition: Tall open forest with mesic understorey, often dense close to creek-lines. Species recorded in Ku-ring-gai are listed below. Species underlined are characteristic as listed in Final Determination and those in bold are diagnostic species of DECCW (2009a).

Canopy trees: *Eucalyptus saligna*, *Eucalyptus pilularis*, *Syncarpia glomulifera*, *Angophora costata*, *A. floribunda*, *Ficus rubiginosa*.

Smaller trees: *Pittosporum undulatum*, *Allocasuarina torulosa*, *Acacia elata*, *A. parramattenis*, *A. irrorata*, *A. decurrens*, *Tristaniopsis laurina*, *Acmena smithii*, *Elaeocarpus reticulatus*, *Rapanea variabilis*, *Ceratopetalum gummiferum*, *Callicoma serratifolia*, *Ficus coronata*.

Shrubs: *Breynia oblongifolia*, *Pittosporum undulatum*, *Polyscias sambucifolia*, *Notelaea longifolia*, *Pittosporum revolutum*, *Clerodendrum tomentosum*, *Dodonaea triquetra*, *Omalanthus populifolius*, *Platylobium formosum*, *Leucopogon juniperinus*, *Maytenus silvestris*, *Acacia floribunda*, *A. longifolia*, *Ozothamnus diosmifolius*, *Acrotriche divaricata*, *Zieria smithii*, *Solanum aviculare*.

Ground layer-graminoids: *Entolasia marginata*, *Poa affinis*, *Microlaena stipoides*, *Oplismenus aemulus*, *Oplismenus imbecillus*, *Dichelachne micrantha*, *Echinopogon ovatus*, *Austroanthonia racemosa*, *Lomandra longifolia*, *Carex inversa*, *Cyperus gracilis*, *Lepidosperma laterale*, *Juncus usitatus*.

Ground layer-ferns & herbs: *Adiantum aethiopicum*, *Calochlaena dubia*, *Blechnum cartilagineum*, *Cyathea australis*, *Doodia aspera*, *Pteridium esculentum*, *Pseuderanthemum variabile*, *Centella asiatica*, *Siegesbeckia orientalis*, *Dianella caerulea*, *Geranium homeanum*, *Viola hederacea*, *Hydrocotyle tripartita*, *Pratia purpurascens*, *Oxalis exilis*.

Climbers: *Commelina cyanea*, *Eustrephus latifolius*, *Pandorea pandorana*, *Cayratia clematidea*, *Smilax glyciophylla*, *Clematis glycinoides*, *Glycine microphylla*, *Glycine clandestina*, *Tylophora barbata*, *Hibbertia scandens*, *Kennedia rubicunda*, *Cissus antarctica*, *Morinda jasminoides*.

Threat level: This is the more common and reserved form of BGHF within LGA, however, often highly modified and weedy. Residential gardens often include smaller creek-lines.

Example locations: Mid to lower slopes of Dalrymple-Hay Nature Reserve and adjoining Council land (Plot BGHFGF1), Sheldon Forest (Figures 3a and 3b), Glade Reserve (Koorra Avenue, Wahroonga). (Figure 3c)

Notes: Good consistency with Final Determination. Representative of a transitional zone between shale and sandstone; often narrow on upper to mid-slopes due to accumulation of deep shale-derived soils as a result of downward movement or slumping with sandstone exposed or close to surface only in channel.

Mapping: Some areas may be mapped within the broader classification of Blue Gum High Forest (*complex*).



Figure 3a

Blue Gum High Forest (*sandstone gully form*), A condition Sheldon Forest



Figure 3b



**Figure 3c Blue Gum High Forest (*sandstone gully form*),
TXUD condition North Pymble - weed dominated ground layer**

SYDNEY TURPENTINE - IRONBARK FOREST

Sydney Turpentine - Ironbark Forest (<i>complex</i>)	STIFC
STIF (<i>typical form</i>)	STIFT
STIF (<i>dry transition form</i>)	STIFD
STIF (<i>wet transition form</i>)	STIFW



Description

Sydney Turpentine-Ironbark Forest (STIF) is a tall to medium open forest found on shale and shale-enriched sandstone associated with ridgelines and slopes in moderate rainfall zones on the coast and hinterland of Sydney. Although now extensively cleared the community was once widely distributed between Sutherland and the Hornsby Plateau with scattered outlier occurrences at Campbelltown, Menai, Kurrajong and Heathcote. The main occurrence of STIF is at elevations between 10 and 180 metres above sea level in areas receiving between 900 and 1250 mm of mean annual rainfall (DEEC 2009a). Within the Ku-ring-gai LGA, STIF typically occurs down slope of BGHF at higher altitudes and becomes the dominant community at lower altitudes close to the edge of the shale plateau e.g. along Mona Vale Road at St. Ives, southern end of Fox Valley Road and West Pymble. Soils are generally shallower with lower clay content than those supporting BGHF.. Relative proportions of the various condition classes are shown in Table 7.

Table 7: Area (ha) of Sydney Turpentine-Ironbark Forest (all forms) with various condition classes within Ku-ring-gai LGA

Community	A	B	TXND/TXN	TXUD/TXU	CMI / R
Sydney Turpentine-Ironbark Forest	25.40	1.27	21.79	304.75	0.30

STIF within Ku-ring-gai is dominated by Turpentine *Syncarpia glomulifera*, Blackbutt *Eucalyptus pilularis* and Smooth-barked Apple *Angophora costata*. The floristics are highly variable and determined largely by topography, aspect and proximity to the sandstone boundary.

Three forms of STIF are identified within the LGA:

- *typical form* occurring along ridgelines and upper slopes (part of the Shale Forest Association)
- two shale/sandstone transitional forms (dry transition and wet transition) on exposed and sheltered slopes respectively.

The drier form has been extensively cleared. STIF (wet transition form) is the most common form protected by its association with sandstone gullies. As the gullies become larger down-slope and the sandstone influence increases, STIF is replaced by sandstone forest communities with a shale influence. The exact boundary between STIF and these sandstone gully forest communities for any particular location may require further field survey and assessment. The three forms are described in detail below. Relative proportions of the three forms are shown in Table 8.

Table 8: Mapped areas (ha) of STIF (*complex*) and forms within Ku-ring-gai with reference to condition

Condition Class	A / B	TXND / TXN	TXUD / TXU	CMI / R
Sydney Turpentine - Ironbark Forest (<i>complex</i>)	6.85	8.00	155.73	
STIF (<i>typical form</i>)	3.46	2.77	24.11	
STIF(<i>dry transition form</i>)	0.58	3.27	66.94	
STIF (<i>wet transition form</i>)	15.77	7.75	57.97	0.30

Threats

Threats are very high particularly clearing along the ridgelines where there is a high demand for land for urban consolidation and transport services. Remnants are small and scattered. Down-slope the main threats are small-scale residential clearing (particularly in flatter sites away from gullies), nutrient enrichment, garden escapes and weed invasion. The NSW Scientific Committee (1997) also identifies physical damage from recreational activities, rubbish dumping, grazing and mowing.

Conservation Status

Sydney Turpentine Ironbark Forest is listed as an Endangered Ecological Community under the NSW *Threatened Species Conservation Act 1995* (TSC Act). Sydney Turpentine Ironbark Forest in the Sydney Basin Bioregion is also listed as Critically Endangered Ecological Community under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The endangered status of STIF is likely to be confirmed for all three forms. The typical form is the rarest and of highest conservation significance.

Table 9: Conservation status of Sydney Turpentine Ironbark Forest (*complex*) and forms within Ku-ring-gai

	Vegetation community	Area within Ku-ring-gai (ha) (excluding DECCW lands)				
		A / B	TXND / TXN	TXUD / TXU	CMI / R	TOTAL
Council natural area	Sydney Turpentine - Ironbark Forest (<i>complex</i>)	4.86	0.81	2.64		8.31
	STIF (<i>typical form</i>)	1.88	1.04	0.06		2.98
	STIF (<i>dry transition form</i>)		0.56	0.17		0.73
	STIF (<i>wet transition form</i>)	8.96	2.75	5.85	0.21	17.76
TOTAL		15.70	5.16	8.73	0.21	29.80
Other council managed lands	Sydney Turpentine - Ironbark Forest (<i>complex</i>)	0.01	1.05	9.90		10.96
	STIF (<i>typical form</i>)			2.20		2.20
	STIF (<i>dry transition form</i>)	0.55	0.73	0.69		1.97
	STIF (<i>wet transition form</i>)	0.63	0.82	1.34		2.80
TOTAL		1.20	2.60	14.12	0.00	17.92
Other lands (excluding DECCW estate)	Sydney Turpentine - Ironbark Forest (<i>complex</i>)	1.98	6.14	143.21		151.33
	STIF (<i>typical form</i>)	1.03	1.00	23.36		25.39
	STIF (<i>dry transition form</i>)	0.58	2.71	64.57		67.86
	STIF (<i>wet transition form</i>)	6.18	4.19	50.77	0.09	61.22
TOTAL		9.77	14.03	281.91	0.09	305.80
Total extant area		26.67	21.79	304.76	0.30	353.52

In some areas the forms are not distinct or change frequently over short distances due to intermediate or variable environmental conditions (e.g. as found in gently undulating topography) and are mapped as STIF (*complex*).

Many remnants previously mapped as STIF by Council and DECCW, associated with ridgelines & upper slopes, are now included within BGHF (*dry form*). The extent of STIF (*typical form*) is likely, therefore, to be less than previously calculated.

Relationship to Other Communities

Sydney Turpentine-Ironbark Forest is closely related to Blue Gum High Forest with many shared species. Together these communities represent a unique Shale Forest Association in higher rainfall areas of the Sydney region. The transitional forms are closely related to Coastal Shale Sandstone Forest (CSSF) but are representative of the shale end of the transition.

Relationship to Other Mapping

Sydney Turpentine-Ironbark Forest fits within the:

- statewide class *Northern Hinterland Wet Sclerophyll Forest* (Keith 2004)
- PVP biometric vegetation type *Turpentine – Grey Ironbark open forest on shale in the lower Blue Mountains and Sydney Basin* (DECCW 2009)
- Sydney Metropolitan Catchment Management Authority Area mapping unit Sydney Turpentine-Ironbark Forest (S_WSF09) (DECCW 2009a)
- Sydney Turpentine-Ironbark (WSF p87) regional map unit (Tozer *et al* 2006).

The Sydney Turpentine - Ironbark Forest (*dry transition form*) is equivalent to Turpentine-Ironbark Margin Forest (TIMF) of Tozer (2003).

Species Richness

Total number of species recorded:

Plots (20 m x 20 m) generally contain over 40 native species with the % of indicator shale species >55% in the typical form away from sandstone influence and 40-50% in more transitional areas.

Geology: Ashfield Shale of the Wianamatta Group, rarely Hawkesbury Sandstone.

Altitude: Mostly 70-150 m above sea level but occasionally recorded to 180 m where adjacent to steeper sandstone gullies at higher elevations.

Soil landscape & characteristics: Predominantly Glenorie (Gn), also Lucas Heights & Gynea. Medium depth brown to orange-brown sandy clay loam – medium to high clay content; ironstone gravels and sandstone fragments may be present but very localised.

Habitat: Mostly secondary ridges, lower plateaus & moderate to gentle slopes. Exposed or sheltered conditions. In the vicinity of creek lines with increasing sandstone influence the typical form is replaced by transitional forms.

Vegetation structure & composition: Tall to medium open forest with shrubby or grassy understorey depending on level of disturbance and time since fire. Within Ku-ring-gai the typical form of STIF is often dominated by Blackbutt *Eucalyptus pilularis* rather than Turpentine. Species recorded in Ku-ring-gai are listed below. Species underlined are characteristic as listed in Final Determination and those in bold are diagnostic species of DECCW (2009a).

Canopy trees: *Eucalyptus pilularis*, *Syncarpia glomulifera*, *Angophora costata*, *Eucalyptus resinifera*, *Eucalyptus paniculata*, *Angophora floribunda*, *Eucalyptus acmenoides*, *Eucalyptus saligna*.

Smaller trees: *Pittosporum undulatum*, *Acacia implexa*, *A. parramattensis*, *Elaeocarpus reticulatus*, *Allocasuarina littoralis*, *A. torulosa*, *Exocarpos cupressiformis*.

Shrubs: *Breynia oblongifolia*, *Ozothamnus diosmifolius*, *Omalanthus populifolius*, *Polyscias sambucifolia*, *Pittosporum revolutum*, *Platylobium formosum*, *Indigofera australis*, *Bursaria spinosa*, *Leucopogon juniperinus*, *Zieria smithii*, *Acacia longifolia*, *Dodonaea triquetra*, *Hibbertia aspera*, *Kunzea ambigua*.

Ground layer-graminoids: *Entolasia marginata*, *Entolasia stricta*, *Microlaena stipoides*, *Oplismenus aemulus*, *O. imbecillus*, *Aristida vagans*, *Austrodanthonia racemosa*, *A. tenuior*, *Echinopogon ovatus*, *Echinopogon caespitosus*, *Dichelachne species*, *Poa affinis*, *Lepidosperma laterale*, *Panicum simile*, *Themeda australis*, *Lomandra longifolia*, *Lomandra filiformis*, *Lomandra multiflora*, *Cyperus gracilis*, *Imperata cylindrica var. major*.

Ground layer-ferns & herbs: *Pteridium esculentum*, *Calochlaena dubia*, *Dichondra repens*, *Centella asiatica*, *Dianella caerulea*, *Oxalis perennans*, *Geranium homeanum*, *Desmodium varians*, *Veronica plebeia*, *Wahlenbergia gracilis*, *Brunoniella australis*, *Pratia purpurascens*, *Pterostylis nutans*, *Desmodium rhytidophyllum*, *Dianella longifolia*, *Opercularia diphyllo*, *Goodenia hederacea*, *Galium gaudichaudii*.

Climbers: *Hardenbergia violacea*, *Glycine microphylla*, *Glycine clandestina*, *G. tabacina*, *Kennedia rubicunda*, *Clematis species*, *Commelina cyanea*, *Pandorea pandorana*, *Geitonoplesium cymosum*, *Eustrephus latifolius*, *Smilax glyciophylla*, *Tylophora barbata*, *Billardiera scandens*, *Cassytha species*.

Threat level: This form is considerably rarer than the transitional forms. Most examples are very small and show some evidence of intergrading with other communities e.g. BGHF or are highly modified through clearing or plantings. Several remnants previously identified as STIF are now mapped as BHGF (dry form).

Examples: Bicentennial Park (West Pymble) (Figure 4a), Water Board land adjacent to Dalrymple-Hay Nature Reserve, St. Ives district e.g. Memorial Park, Gillots Way and Lindfield district., Catalpa Avenue, Turramurra (Figure 4b).

Notes: Similar to BGHF (*dry form*) but lower altitude with more shallow soils closer to sandstone boundary.

Mapping: Some areas may be mapped within the broader classification of Sydney Turpentine - Ironbark Forest (*complex*)



Figure 4a STIF (*typical form*), A condition
Bicentennial Park



Figure 4b STIF (*typical form*), TXUD condition
Catalpa Avenue, Turramurra

Sydney Turpentine-Ironbark Forest (*dry transition form*) STIFD

Geology: Mostly Mittagong Formation, also Ashfield Shale and Hawkesbury Sandstone.

Altitude: Mostly 60-130 m above sea level but up to 190 m in higher areas e.g. Wahroonga, Warrawee & Turramurra districts where shale is close to deeper sandstone gullies.

Soil landscape & characteristics: Lucas Heights, Gynea, transitional areas between Glenorie & Lucas Heights. Medium deep soils, yellow to orange or brown silty or sandy clay loam with loose sandstone fragments & ironstone gravels typically present.

Habitat: Secondary crests, benches, spurs & gentle mid-slopes; relatively exposed conditions. Often short distance upslope of shale/sandstone boundary.

Vegetation structure & composition: Medium to low open forest with typically drier understorey of scattered sclerophyllous shrubs and grassy ground cover. Species recorded in Ku-ring-gai are listed below. Species underlined are characteristic as listed in Final Determination and those in bold are diagnostic species of DECCW (2009a).

Canopy trees: *Angophora costata*, *Eucalyptus resinifera*, *Eucalyptus globoidea*, ***Syncarpia glomulifera***, ***Eucalyptus pilularis***, *Angophora floribunda*, *Corymbia gummifera*.

Smaller trees: *Pittosporum undulatum*, *Acacia implexa*, *A. parramattenis*, *Allocasuarina littoralis*.

Shrubs: *Ozothamnus diosmifolius*, *Leucopogon juniperinus*, *Bursaria spinosa*, *Breynia oblongifolia*, *Zieria smithii*, *Kunzea ambigua*, *Acacia floribunda*, *Acacia terminalis*, *Acacia ulicifolia*, *Acacia longifolia*, *Pultenaea flexilis*.

Ground layer-graminoids: *Entolasia stricta*, *Entolasia marginata*, *Microlaena stipoides*, *Oplismenus aemulus*, *Austrodanthonia racemosa*, *Austrodanthonia tenuior*, *Aristida vagans*, *Echinopogon ovatus*, *Echinopogon caespitosus*, *Themeda australis*, *Lomandra longifolia*. ***Lomandra filiformis***, *Lomandra multiflora*, *Cyperus gracilis*, *Carex inversa*, *Austrostipa rudis*, *Dichelachne micrantha*, *Eragrostis brownii*, *Bothriochloa decipiens*

Ground layer-ferns & herbs: *Pteridium esculentum*, *Dichondra repens*, *Dianella caerulea*, *Oxalis perennans*, *Desmodium varians*, *Veronica plebeia*, *Wahlenbergia gracilis*, *Poranthera microphylla*, *Euchiton sphaericus*, *Plantago debilis*, *Wahlenbergia gracilis*, *Goodenia hederacea*, ***Pratia purpurascens***

Climbers: *Hardenbergia violacea*, ***Glycine microphylla***, *Glycine tabacina*, ***Glycine clandestina***, *Kennedia rubicunda*.

Threat level: High development pressure with habitat typically level or gently sloping.

Examples: Mostly small highly modified remnants along road reserves and in private yards e.g. Lawley Crescent (Pymble) (Figure 5a), Catalpa Crescent & Warragal Road (Turramurra) (Figures 5b and 5c), Murdoch Street (Turramurra), Murrua Road (North Turramurra).

Mapping: Some areas may be mapped within the broader classification of Sydney Turpentine - Ironbark Forest (*complex*).



Figure 5a **STIF (Dry Transition)**,
TXUD condition Lawley Crescent, Pymble



Figure 5b **STIF (Dry Transition)**,
TXUD condition Catalpa Crescent, Turramurra



Figure 5c **STIF (Dry Transition)**,
TXU condition Carlotta Avenue, Pymble

Sydney Turpentine-Ironbark Forest (*wet transition form*) STIFW

Geology: Mostly Mittagong Formation, also Ashfield Shale & Hawkesbury Sandstone.

Altitude: Mostly 80-150 m above sea level.

Soil landscape & characteristics: Most commonly Lucas Heights (lh) & Gynea (gy), also Glenorie (gn). Medium to shallow brown to orange-brown sandy clay loam – sandstone fragments or minor outcrops may be present close to creeks.

Habitat: Mid to lower, sheltered slopes approaching the shale/sandstone boundary, often associated with sandstone gullies.

Vegetation structure & composition: Medium to tall open forest with well developed mesic understorey. Turpentine *Syncarpia glomulifera* and Blackbutt *Eucalyptus pilularis* are typically dominant canopy trees. Species recorded in Ku-ring-gai are listed below. Species underlined are characteristic as listed in Final Determination and those in bold are diagnostic species of DECCW (2009a).

Canopy trees: *Syncarpia glomulifera* (D), *Angophora costata*(D), *Eucalyptus pilularis*(D), *Angophora floribunda*, *E. paniculata*, *E. globoidea*.

Smaller trees: *Pittosporum undulatum*, *Allocasuarina torulosa*, *Acacia implexa*, *Acacia parramattensis*, *Acacia elata*, *Elaeocarpus reticulatus*, *Ceratopetalum gummiferum*, *Tristaniopsis laurina*, *Omalanthus populifolius*.

Shrubs: *Breynia oblongifolia*, *Polyscias sambucifolia*, *Pittosporum revolutum*, *Platylobium formosum*, *Dodonaea triquetra*, *Leucopogon juniperinus*, *Maytenus silvestris*, *Notelaea longifolia*, *Acacia floribunda*, *A. longifolia*, *Zieria smithii*, *Hibbertia aspera*, *Xanthosia pilosa*.

Ground layer-graminoids: *Entolasia marginata*, *Entolasia stricta*, *Poa affinis*, *Microlaena stipoides*, *Oplismenus aemulus*, *O. imbecillus*, *Imperata cylindrica* var. *major*, *Echinopogon ovatus*, *E. caespitosus*, *Lomandra longifolia*, *Cyperus gracilis*, *Lepidosperma laterale*, *Panicum simile*.

Ground layer-ferns & herbs: *Dichondra repens*, *Centella asiatica*, *Pseuderanthemum variabile*, *Pratia purpurascens*, *Dianella caerulea*, *Oxalis perennans*, *Geranium homeanum*, *Desmodium varians*, *Veronica plebeia*, *Cryptostylis erecta*, *Calochlaena dubia*, *Cyathea australis*, *Pteridium esculentum*, *Blechnum cartilagineum*, *Lindsaea linearis*.

Climbers: *Hardenbergia violacea*, *Glycine microphylla*, *Kennedia rubicunda*, *Eustrephus latifolius*, *Pandorea pandorana*, *Clematis glycinoides*, *Geitonoplesium cymosum*, *Hibbertia dentata*, *Morinda jasminoides*, *Cayratia clematidea*, *Stephania japonica* var. *discolor*.

Threat level: This form is more common than the typical form of STIF due to the high frequency of smaller creek-lines and less suitability of land for development.

Examples: Represented within the following reserves; Richmond Park & Gordon Glen (Figure 6a) (Gordon); Huntleys Forest (St. Ives), Golfers Glen(Figure 6b) (Pymble).

Notes: Areas mapped as wet transition along creek-lines will generally inter-grade into a more sandstone environment supporting Coastal Shale Sandstone Forest (CSSF) or Sydney Sandstone Gully Forest (SSGF), largely dependant on the degree of slope and extent of shale influence. The sandstone gully forest will often have a distinct shale influence and may be consistent with the community Coastal Enriched Sandstone Moist Forest (S_WSF02) of DECCW (2009a). Along smaller creek-lines at higher altitudes, however, the wet transition form of STIF may extend right to the creek. The mapped boundary of the wet transition form of STIF with SSGF should be used as a guide only due to the intergrading nature of the boundary, local variability and limited survey. Specific site survey is required for more detailed assessment.

Mapping: Some areas may be mapped within the broader classification of Sydney Turpentine - Ironbark Forest (*complex*). The area mapped as STIF (*wet transition form*) may be overestimated, due to the:

- transitional nature of this community,
- similarity of canopy species to those found in adjoining sandstone communities, and
- limited field survey of sandstone environments.



Figure 6a STIF (*wet transition form*)
Gordon Glen Reserve - close to creek



Figure 6b STIF (*wet transition form*)
Golfers Glen - away from creek

COASTAL SHALE SANDSTONE FOREST

Coastal Shale Sandstone Forest* (complex) **CSSFC*

Coastal Shale Sandstone Forest* (taller forest form) **CSSFT*

Coastal Shale Sandstone Forest* (low forest/woodland form) **CSSFF*



Description

Coastal Shale Sandstone Forest (CSSF) is a variable tall, open eucalypt forest found in higher rainfall, shale-sandstone transitional areas of the Hornsby and Woronora Plateaus, north and south of Sydney. In Ku-ring-gai, at least, a low forest or woodland form also occurs. In drier areas mostly to the west of Sydney (edge of Blue Mountains plateau) CSSF is replaced by Shale Sandstone Transition Forest, an endangered ecological community listed under the *TSC Act* and *EPBC Act*.

CSSF is found on clay influenced soils associated with residual shale or lateritic capping, shale beds in sandstone or transitional soils on slopes at the shale/sandstone boundary. Tree species are variable depending on location but within Ku-ring-gai the most common canopy species are Blackbutt *Eucalyptus pilularis*, Smooth-barked Apple *Angophora costata*, Red Mahogany *Eucalyptus resinifera*, Turpentine *Syncarpia glomulifera* and Red Bloodwood *Corymbia gummifera*. In drier habitats close to the sandstone boundary a low forest or woodland form contains additional sandstone species including Scribbly Gums *Eucalyptus haemastoma* and *E. racemosa*, Silvertop Ash *Eucalyptus sieberi* and Sydney Peppermint *Eucalyptus piperita*.

Relative proportions of the various condition classes are shown in Table 10.

Table 10: Area (ha) of Coastal Shale Sandstone Forest (all forms) with various condition classes within Ku-ring-gai LGA

Community	A	B	TXND/ TXN	TXUD / TXUD	CMI / R
Coastal Shale Sandstone Forest	23.63	0.25	6.88	60.11	-

Coastal Shale Sandstone Forest is a newly described community (DECCW 2009a) and belongs to the statewide class *Northern Hinterland Wet Sclerophyll Forests*. The PVP biometric vegetation type is tentatively identified as *Sydney Shale – Ironstone Forest*. The floristics is highly variable and determined largely by location, topography, aspect and proximity to the sandstone boundary. She-oaks *Allocasuarina littoralis* and *A. torulosa* are often common smaller trees above scattered

sclerophyllous shrubs and a grassy ground layer. A range of groundcovers typical of clay soils generally persist including *Dichondra repens*, *Centella asiatica*, *Pratia purpurascens*, *Veronica plebeia*, *Aristida vagans*, *Themeda australis*, and *Microlaena stipoides*.

Two forms of CSSTF are recognized. A taller forest with medium sandstone influence is found on deeper shale or lateritic caps and hill-slopes, CSSTF (*taller forest form*) and a low forest or woodland form with higher sandstone influence, CSSTF (*low forest/woodland form*). In larger areas of transitional geology the two forms may inter-grade. Taller forest occurring on a shale cap at South Turramurra (Auluba Reserve & adjoining areas) was previously identified as Duffys Forest (Blackbutt Form) in Smith & Smith (2000). The low forest/woodland form is more extensive than the taller form and is largely found on ridges, plateaus, benches or gentle slopes but has been extensively cleared and highly modified.

Relative proportions of the forms are shown in Table 11.

Table 11: Mapped areas (ha) of Coastal Shale Sandstone Forest (*complex*) and forms within Ku-ring-gai LGA with reference to condition classes

Condition class	A / B	TXND / TXN	TXUD / TXU	CMI / R
Coastal Shale Sandstone Forest (<i>complex</i>)	4.16	2.85	20.30	–
CSSTF (<i>taller forest form</i>)	13.26	1.27	21.14	–
CSSTF (<i>low forest/woodland</i>)	6.47	2.76	18.67	–

Threats

Threats are high particularly in flatter ridgetop or plateau areas where clearing for urban development has been extensive. Hill-slope remnants are generally narrow in extent and vulnerable to nutrient enrichment, garden escapes and weed invasion.

Conservation Status

Coastal Shale Sandstone Forest is equivalent to the listed endangered Shale Sandstone Transition Forest community and likely to warrant clarification in the determination. All forms appear to be naturally restricted and vulnerable to development and on-going degradation.

Legal status to be determined through consultation with DECCW, upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)

Within the Ku-ring-gai LGA there are remnants of CSSF on shale caps e.g. Auluba Reserve at Turramurra that are still consistent with the Blackbutt form of Duffys Forest as described in the Final Determination for this community.

Table 12: Conservation status of Coastal Shale Sandstone Forest (*complex*) and forms within Ku-ring-gai

	Vegetation community	Area within Ku-ring-gai (ha) (excluding DECCW lands)				
		A / B	TXND / TXN	TXUD / TXU	CMI / R	TOTAL
Council natural area	Coastal Shale Sandstone Forest (<i>complex</i>)	1.45	0.42	1.13	-	3.00
	CSSTF (<i>taller forest form</i>)	4.59	0.07	3.57	-	8.22

	CSSTF (<i>low forest/woodland</i>)	2.82	0.27	0.62	-	3.70
TOTAL		8.85	0.76	5.32	-	14.93
Other council managed lands	Coastal Shale Sandstone Forest (<i>complex</i>)	0.25	0.02	0.70	-	0.96
	CSSTF (<i>taller forest form</i>)	0.89	0.52	0.51	-	1.92
	CSSTF (<i>low forest/woodland</i>)	1.35	0.96	1.35	-	3.65
TOTAL		2.48	1.50	2.56	-	6.54
Other lands (excluding DECCW estate)	Coastal Shale Sandstone Forest (<i>complex</i>)	2.47	2.41	18.47	-	23.34
	CSSTF (<i>taller forest form</i>)	2.30	1.53	16.70	-	20.53
	CSSTF (<i>low forest/woodland</i>)	7.78	0.69	17.06	-	25.53
TOTAL		12.55	4.62	52.24	-	69.41
Total extant area		23.88	6.88	60.11	-	90.87

Relationship to Other Communities

CSSF is a coastal form of the closely related endangered Shale Sandstone Transition Forest of western Sydney. Within Ku-ring-gai CSSF shares similar habitat and floristics to the transitional forms of Sydney Turpentine-Ironbark Forest but can be identified by the higher sandstone influence. A low forest/woodland form is similar to Duffys Forest (DF) but differs primarily in relation to landscape position and sandstone influence. CSSF has a stronger geographical link to the shale environment as reflected in a higher representation of shale species. Ironstone gravels can be found in both DF and CSSF. It should be noted that remnants of CSSF located on shale caps e.g. Auluba Reserve at Turramurra are still consistent with the Blackbutt form of Duffys Forest as described in the Final Determination for this community.

Relationship to Other Mapping

Coastal Shale Sandstone Forest fits within the:

- statewide class *Northern Hinterland Wet Sclerophyll Forest* (Keith 2004)
- PVP biometric vegetation type is a component of *Red Bloodwood - Smooth-barked Apple shrubby forest on shale or ironstone of coastal plateaux, Sydney Basin* (DECCW 2009)
- Sydney Metropolitan Catchment Management Authority Area mapping unit Coastal Shale-Sandstone Forest (S_WSF06 p65) (DECCW 2009)
- Sydney Shale-ironstone Cap Forest (DSF p143) regional map unit (Tozer *et al* 2006).

Species Richness

Total number of species recorded:

Plots (20 m x 20 m) generally contain between 40 and 50 native species with the % of indicator shale species between 25 and 50% for both forms.

Geology: Shale with sandstone influence (includes Mittagong Formation).

Altitude: Mostly 60-100 m above sea level in southern parts of the LGA but up to 170 m in North Turrumurra where deeply incised creeks.

Soil landscape & characteristics: Lucas Heights (lh), Gynea (gy). Shallow, sandy clay-loam with sandstone fragments & minor to moderate rock outcrops.

Habitat: Broader plateaus with shale cap and gentle to moderate slopes close to or at shale/ sandstone boundary.

Vegetation structure composition: Open forest (mostly 15 – 35 m high) with smaller tree layer, scattered shrubs and grassy understorey. Species recorded in Ku-ring-gai are listed below. Species underlined are characteristic as listed in Final Determination for the similar Shale Sandstone Transition Forest (SSTF) EEC and those in bold are diagnostic species of CSSF of DECCW (2009a).

Canopy trees: *Eucalyptus pilularis*, *Angophora costata*, *Eucalyptus resinifera*, *Eucalyptus globoidea*, *Eucalyptus punctata*, ***Syncarpia glomulifera***, *Corymbia gummifera*, *Eucalyptus haemastoma*.

Smaller trees: *Pittosporum undulatum*, *Acacia implexa*, *Acacia parramattensis*, ***Allocasuarina littoralis***, *Acacia binervia*, *Acacia elata*, *Elaeocarpus reticulatus*, *Glochidion ferdinandi*, *Persoonia levis*.

Shrubs: *Ozothamnus diosmifolius*, ***Leucopogon juniperinus***, *Bursaria spinosa*, ***Polyscias sambucifolia***, *Kunzea ambigua*, ***Acacia myrtifolia***, ***Acacia linifolia***, *Persoonia linearis*, *Persoonia pinifolia*, ***Hakea sericea***, ***Dodonaea triquetra***, *Grevillea linearifolia*, ***Bossiaea obcordata***, ***Lomatia silaifolia***, *Acacia longifolia*, *Acacia suaveolens*, *Pultenaea flexilis*, *Epacris pulchella*, *Hibbertia aspera*, *H. empetrifolia*, ***Micrantheum ericoides***.

Ground layer-graminoids: *Entolasia stricta*, *E. marginata*, *Microlaena stipoides*, *Oplismenus aemulus*, *Austrodanthonia racemosa*, *Austrodanthonia tenuior*, *Echinopogon ovatus*, *Echinopogon caespitosus*, ***Themeda australis***, *Dichelachne micrantha*, *Digitaria ramularis*, *Aristida vagans*, ***Austrostipa pubescens***, *Austrostipa rudis*, *Eragrostis leptostachya*, *Eragrostis brownii*, ***Imperata cylindrica*** var. ***major***, *Lepidosperma laterale*, *Cyperus gracilis*, *Lomandra longifolia*, *Lomandra filiformis*, ***Lomandra multiflora***, ***Lomandra obliqua***, *Xanthorrhoea media*.

Ground layer-ferns & herbs: *Pteridium esculentum*, *Brunoniella australis*, *Dichondra repens*, *Dianella caerulea*, *Cryptostylis erecta*, *Oxalis perennans*, *Pomax umbellata*, *Desmodium varians*, *Veronica plebeia*, *Wahlenbergia gracilis*, *Poranthera microphylla*, *Goodenia heterophylla*, ***Goodenia hederacea***, ***Pratia purpurascens***, *Commelina cyanea*, *Euchiton sphaericus*.

Climbers: *Hardenbergia violacea*, *Glycine microphylla*, *Glycine tabacina*, *Kennedia rubicunda*, ***Cassitya pubescens***, *Pandorea pandorana*, ***Smilax glycyphylla***, ***Billardiera scandens***.

Threat level: This community occurs with a restricted natural occurrence. Core distribution of CSSF is likely within the Ku-ring-gai LGA. CSSF is known to provide habitat for two threatened species within Ku-ring-gai – *Epacris purpurascens* var. *purpurascens* and *Acacia pubescens*.

Examples: Council reserves on either side of gully north of Burns Road (Turrumurra) , e.g. Milkmaids Reserve (Figure 7a) Grevillea Walk (Figure 7b) and in the vicinity of Clissold Road, Wahroonga.. Kissing Park Oval (Auluba Reserve), South Turrumurra is a remnant on a shale cap (Figures 7c and 7d)

Notes: Typically a narrow zone of gentle gradient with steeper slopes below. Not as distinct floristically as the listed endangered SSTF of western Sydney. Plot data for example sites indicates presence of 30 – 45% of characteristic SSTF species as listed in Final Determination. Generally a higher consistency with STIF is found and most commonly occurs below this community. At wetter sites on steeper gully slopes this community may inter-grade down slope into Coastal Enriched Sandstone Sheltered Forest (S_DSF04) or Coastal Enriched Sandstone Moist Forest (S_WSF02) (DECCW 2009a).

Mapping: Some areas may be mapped within the broader classification of Coastal Shale Sandstone Forest (*complex*). Although extensively checked there may still be some CSSTF (*taller forest form*) areas mapped as other communities, due to the small size of remnants and similarities with other transitional communities.



**Figure 7a CSSF (*taller forest form*),
A condition Milkmaids Reserve**



**Figure 7b CSSF (*taller forest form*),
A condition Grevillea Walk – some plantings**



**Figure 7c CSSF (*taller forest form*),
Condition A South Turramurra, on
shale cap**



**Figure 7d CSSF (*taller forest form*),
Condition TXUD South Turramurra, on
shale cap**

Coastal Shale Sandstone Forest (*low forest/woodland form*) **CSSFF**

Geology: Transitional areas between shale and sandstone with medium to high sandstone influence (mostly Mittagong Formation).

Altitude: Variable - 160-190 m above sea level at Wahroonga (Junction & Carrington Roads, Barton Av), 100-110 m at South Turrumurra; 110-130 m (Kissing Point Road).

Soil landscape & characteristics: Predominantly Lucas Heights, also Gynea. Shallow, sandy loam or sandy, clay-loam, typically with sandstone fragments and/or ironstone gravels, occasional rock outcrops.

Habitat: Ridges, crests, benches and upper to mid slopes close to sandstone environment, includes exposed and more sheltered aspects.

Vegetation structure: Low forest to woodland in more exposed sites. Species recorded in Ku-ring-gai are listed below. Species underlined are characteristic as listed in Final Determination for the similar Shale Sandstone Transition Forest (SSTF) EEC and those in bold are diagnostic species of CSSF of DECCW (2009a).

Canopy trees: *Eucalyptus haemastoma* (D), *Eucalyptus racemosa* (C), *Corymbia gummifera* (D), ***Eucalyptus resinifera*** (C), ***Angophora costata***, *Eucalyptus sieberi*., *Eucalyptus globoidea*, *Eucalyptus oblonga*, *Eucalyptus sparsifolia*, *Eucalyptus capitellata*; (*Eucalyptus piperita*, ***Eucalyptus pilularis*** – on more sheltered slopes).

Smaller trees: *Acacia parramattensis*, *Acacia decurrens*, *Banksia serrata*, ***Pittosporum undulatum***, *Elaeocarpus reticulatus*, ***Allocasuarina littoralis***, *Persoonia levis*, *Leptospermum trinervium*.

Shrubs: *Kunzea ambigua*, ***Dodonaea triquetra***, ***Lomatia silaifolia***, *Acacia terminalis*, ***Acacia linifolia***, ***Acacia myrtifolia***, *Acacia ulicifolia*, ***Banksia spinulosa*** var. ***spinulosa***, ***Bossiaea obcordata***, *Lambertia formosa*, *Acacia longifolia*, *Hibbertia empetrifolia*, *Hibbertia aspera*, *Ozothamnus diosmifolius*, ***Polyscias sambucifolia***, ***Leucopogon juniperinus***, *Persoonia pinifolia*, ***Hakea sericea***, ***Micranthemum ericoides***, *Grevillea sericea*, ***Phyllanthus hirtellus***, *Grevillea buxifolia*, *Pultenaea tuberculata*, *Bursaria spinosa*, ***Leptospermum trinervium***, *Epacris pulchella*, *Gonocarpus tetragynus*.

Ground layer-graminoids: *Echinopogon ovatus*, *Echinopogon caespitosus*, *Cyperus gracilis*, *Microlaena stipoides*, *Oplismenus aemulus*, *Eragrostis brownii*, *Aristida vagans*, *Aristida ramosa*, *Bothriochloa species*, ***Themeda australis***, *Panicum simile*, *Lomandra longifolia*, ***Lomandra obliqua***, *Lomandra glauca*, ***Austrostipa pubescens***, *Austrostipa rudis*, ***Cyathochaeta diandra***, ***Imperata cylindrica*** var. ***major***, *Lepidosperma laterale*, *Entolasia stricta*, *Xanthorrhoea media*.

Ground layer-ferns & herbs: *Dichondra repens*, *Centella asiatica*, ***Pratia purpurascens***, *Wahlenbergia gracilis*, *Veronica plebeia*, ***Xanthosia tridentata***, *Actinotus minor*, *Dianella caerulea*, *Rumex brownii*, *Lindsaea microphylla*, *Lindsaea linearis*.

Climbers: *Glycine clandestina*, *Glycine microphylla*, *Kennedia rubicunda*, ***Cassytha pubescens***, *Hardenbergia violacea*.

Threat level: Naturally restricted; highly cleared & developed for roads & houses. Mostly is represented by remnant trees in residential yards and along road reserves, also at edge of national parks and reserves.

Examples: Council open space on the corner of Holt and Barton Avenue, Wahroonga (Figure 8a),CSIRO, West Lindfield (Figure 8b),, Wahroonga (in vicinity of Junction & Carrington Roads), Bobbin Head Road at North Turrumurra, lower section of Kissing Point Road at Turrumurra, Athena Road, St. Ives (Figure 8c),, West Lindfield (Figure 8d). .

Notes: Highly modified due to clearing and development and often difficult to distinguish from SSRW, particularly SSRW with clay influence. It is also very similar floristically to DF. This form is most commonly identified by scattered remnant Scribbly Gums (with occasional trees of *Angophora costata*, *Corymbia gummifera* or *Eucalyptus resinifera*) in gardens and along road reserves on flatter transitional landscapes. A distinct clay influence is evident in the soil with some persistent shale groundcover species including *Dichondra repens*, *Pratia purpurascens*, *Microlaena stipoides*, *Dichelachne micrantha* and *Glycine microphylla*.

Mapping: Some areas may be mapped within the broader classification of Coastal Shale Sandstone Forest (*complex*). Although extensively checked there may still be some areas mapped as SSRW that may be CSSTF (*low forest/woodland*) on transitional landscapes (e.g. Lucas Heights soil landscape).



**Figure 8a CSSF (*low forest/woodland form*),
A condition** Open Space, corner of Holt
and Barton Avenue, Wahroonga



**Figure 8b CSSF (*low forest/woodland form*),
A condition** Road reserve and adjoining CSIRO



**Figure 8c CSSF (*low forest/woodland form*),
condition TXUD** Athena Road, St. Ives



**Figure 8d CSSF (*low forest/woodland form*),
condition TXUD** West Lindfield

Duffys Forest (complex) **DFC**

Duffys Forest (typical form) **DFTY**

Duffys Forest (transition form) **DFT**



Description

Duffys Forest (DF) is a shrubby forest or woodland community of coastal Sydney sandstone. The key features that separate DF from similar sandstone communities is the combination of high rainfall (>1100 mm) and the presence of red ironstone mantles above sandstone. Recent mapping of the Sydney Metropolitan Region (DECCW 2009a) has extended the known occurrence of this community to include areas of lateritic ironstone between Bulli and Sutherland; however, the extent within Ku-ring-gai has been reduced with taller forest previously identified as a Blackbutt form now included within the Coastal Shale-Sandstone Forest community. DF is now restricted within Ku-ring-gai to the northern part of St. Ives and extends to the north beyond the LGA to Duffys Forest, Belrose and Terry Hills. Relative proportions of the various condition classes are shown in Table 13.

Table 13: Area (ha) of Duffys Forest (all forms) with various condition classes within Ku-ring-gai LGA

Community	A	B	TXND / TXND	TXUD / TXU	CMI / R
Duffys Forest	21.57	0.92	9.13	9.54	0.19

DF is dominated by Red Bloodwood (*Corymbia gummifera*), Silvertop Ash (*Eucalyptus seeberi*) and Stringybark (*Eucalyptus capitellata*) or *Eucalyptus oblonga* with Scribbly Gum (*Eucalyptus haemastoma*) less common. The shrub layer is diverse with high representation of members of the Proteaceae family including *Hakea*, *Banksia* and *Persoonia*, above a relatively grassy ground layer.

Two forms of DF are identified within the LGA. Currently Duffys Forest (complex) (DFC) has not been mapped, however, further surveys may include this form.

The typical form of DF is dominated by Red Bloodwood (*Corymbia gummifera*), Red Stringybark (*Eucalyptus capitellata*) and Smooth-barked Apple (*Angophora costata*) and is found on ridgetops, plateaus and upper slopes with some clay influence and distinctive ironstone gravels. A transitional

form between typical DF and adjoining sandstone communities (most commonly Sandstone Ridgetop Woodland) is also recognised and unlike the typical form may have some sandstone outcrops.

A Blackbutt form of DF recorded previously from South Turramurra by Smith & Smith (2000) is identified in this survey and by DECCW (2009a) as CSSTF. The two forms are described in detail below; relative proportions of each are shown in Table 14.

Table 14: Mapped areas (ha) of Duffys Forest (*complex*) and forms within Ku-ring-gai with reference to condition

Condition class	A / B	TXND / TXND	TXUD / TXU	CMI / R
DF (<i>typical form</i>)	14.62	8.61	6.53	0.19
DF (<i>transition form</i>)	7.86	0.52	3.01	-

Threats

Threats are high due to past and ongoing clearing for urban subdivisions (e.g. St. Ives Chase), roads and agriculture. Local impacts have arisen from the digging of gravel pits exploiting the laterite for road building (DECCW 2009a).

Conservation Status

Duffys Forest Ecological Community in the Sydney Basin Bioregion is listed as an Endangered Ecological Community under the NSW *Threatened Species Conservation Act* 1995 (TSC Act). Areas are protected in Garigal, Heathcote, Dharawal and the Royal national parks and reserves.

Table 15: Conservation status of Duffys Forest (*complex*) and forms within Ku-ring-gai

	Vegetation community	Area within Ku-ring-gai (ha) (excluding DECCW lands)				
		A / B	TXND / TXN	TXUD / TXU	CMI / R	TOTAL
Council natural area	Duffys Forest (<i>complex</i>)					
	DF (<i>typical form</i>)	6.46	0.41	0.10	-	6.98
	DF (<i>transition form</i>)	3.85	0.05	-	-	3.90
TOTAL		10.32	0.46	0.10	-	10.88
Other council managed lands	Duffys Forest (<i>complex</i>)					
	DF (<i>typical form</i>)	3.24	6.71	2.66	-	12.61
	DF (<i>transition form</i>)	1.45	0.15	0.53	-	2.12
TOTAL		4.68	6.86	3.19	-	14.73
Other lands (excluding DECCW estate)	Duffys Forest (<i>complex</i>)					
	DF (<i>typical form</i>)	4.92	1.48	3.77	0.19	10.35
	DF (<i>transition form</i>)	2.57	0.33	2.48	-	5.37
TOTAL		7.48	1.81	6.25	0.19	15.73
Total extant area		22.49	9.13	9.54	0.19	41.34

Relationship to Other Communities

Duffys Forest is closely related to CSSF, particularly the low forest-woodland form, and sandstone ridgetop communities with a clay influence.

Relationship to Other Mapping

Duffys Forest fits within the:

- statewide class *Sydney Coastal Dry Sclerophyll Forests* (Keith 2004)
- PVP biometric vegetation type is a component of *Red Bloodwood - Smooth-barked Apple shrubby forest on shale or ironstone of coastal plateaux, Sydney Basin* (DECCW 2009)
- Sydney Metropolitan Catchment Management Authority Area mapping unit Sydney Ironstone Bloodwood-Silvertop Ash Forest (S_DSF14) (DECCW 2009a)
- Sydney Shale-Ironstone Cap Forest (DSF p143) regional map unit (Tozer *et al* 2006).

Species Richness

Total number of species recorded:

Plots (20 m x 20 m) generally contain >50 native species with the % of indicator shale species <20% and the % of characteristic Duffys Forest species generally >70%.

Geology: Typically Mittagong Formation within Hawkesbury Sandstone environment; associated with clay lenses or clay capping.

Altitude: Between 140 - 170 m.

Soil landscape & characteristics: Predominantly Lucas Heights, Gynea and Hawkesbury soil landscapes; small patches of Glenorie may occur locally e.g. St. Ives Chase. Clay loam with distinctive ironstone gravels, typically no sandstone outcrop.

Habitat: Ridgetops, spurs, plateaus or upper slopes, usually upslope of steep slopes on sandstone but can occur on a mid-slope or bench down slope of SSRW.

Vegetation structure & composition: Low open forest with scattered shrubs and grassy groundcover. Species recorded in Ku-ring-gai are listed below. Species underlined are characteristic as listed in Final Determination for Duffys Forest (DF) and those in bold are diagnostic species of DF of DECCW (2009a).

Canopy trees: Corymbia gummifera (D), Angophora costata (D), Eucalyptus capitellata (C), Eucalyptus sieberi (C), Eucalyptus globoidea, Eucalyptus oblonga Eucalyptus haemastoma, Eucalyptus umbra.

Smaller trees: Allocasuarina littoralis, Pittosporum undulatum, Banksia serrata, Banksia ericifolia, Elaeocarpus reticulatus, Ceratopetalum gummiferum, Persoonia levis, Exocarpos cupressiformis.

Shrubs: Lambertia formosa, Banksia spinulosa, Hakea sericea, Bossiaea obcordata, Lomatia silaifolia, Micrantheum ericoides, Phyllanthus hirtellus, Acacia myrtifolia, Acacia linifolia, Acacia longifolia, Dodonaea triquetra, Petrophile pulchella, Ozothamnus diosmifolius, Epacris pulchella, Leptospermum polygalifolium, Hakea dactyloides, Hibbertia aspera, Pultenaea tuberculata.

Ground layer-graminoids: Entolasia stricta, Austrostipa pubescens, Aristida vagans, Austrodanthonia tenuior, Austrodanthonia racemosa, Microlaena stipoides, Themeda australis, Cyathochaeta diandra, Lomandra longifolia, Lomandra obliqua, Lomandra multiflora, Xanthorrhoea media.

Ground layer-ferns & herbs: Pteridium esculentum, Lindsaea linearis, Lindsaea microphylla, Dichondra repens, Dianella caerulea, Dampiera stricta, Actinotus minor, Centella asiatica.

Climbers: Hardenbergia violacea, Glycine clandestina, Kennedia rubicunda.

Threat level: This community has a highly restricted distribution at St. Ives. Larger areas cleared or modified for recreation (St. Ives Showground) or within HART driving centre.

Examples: Restricted occurrence in St. Ives district e.g. St. Ives Showground (Figures 9a and 9b) & HART driving site, Acron Oval.

Notes: Typical form is consistent with DF as described by Smith & Smith (2000), the TSC Act listing and DECCW (2009a). Similar to SSRW with clay influence but latter with higher proportion of sandstone species and greater sandstone outcrops.

Mapping: Some areas may be mapped within the broader classification of Duffys Forest (*complex*). Present mapping likely to be reliable although further checking of DF and CSSF warranted in the St. Ives and St. Ives Chase districts.



Figure 9a Duffys Forest (*typical form*), condition A
St. Ives Showground



Figure 9b Duffys Forest (*typical form*), condition TXND
St. Ives Showground

Geology: Transition zone between Hawkesbury Sandstone and associated clay lenses or shale cap.

Altitude: Mostly 145-155-m above sea level.

Soil landscape & characteristics: Predominantly Lucas Heights, also Gynea and Hawkesbury soil landscapes. Sandy, clay soil with some ironstone gravels and minor to moderate sandstone outcrop.

Habitat: Mid-slopes or edge of bench, sometimes below extensive sandstone outcrops at shale/sandstone boundary.

Vegetation structure & composition: Low forest or woodland with drier more dense shrub understorey if transition to SSRW or more mesic component if transition to SSGF. Scribbly Gum *E. haemastoma* often becomes more common within transition form in more exposed sites. Species recorded in Ku-ring-gai are listed below. Species underlined are characteristic as listed in Final Determination for Duffys Forest (DF) and those in bold are diagnostic species of DF of DECCW (2009a).

Canopy trees: *Corymbia gummifera* (D), ***Angophora costata*** (C), *Eucalyptus sieberi* (C), *Eucalyptus haemastoma* (C), *Eucalyptus oblonga*, *E. sparsifolia*.

Smaller trees: *Allocasuarina littoralis*, ***Banksia serrata***, ***Banksia ericifolia***, *Leptospermum trinervium*.

Shrubs: *Lambertia formosa*, *Acacia longifolia*, *A. suaveolens*, ***Hakea sericea***, ***Bossiaea obcordata***, *Lomatia silaifolia*, ***Micranthemum ericoides***, ***Phyllanthus hirtellus***, *Grevillea linearifolia*, ***Persoonia levis***, ***Persoonia pinifolia***, *Dodonaea triquetra*, ***Petrophile pulchella***, *Ozothamnus diosmifolius*, *Kunzea ambigua*.

Ground layer-graminoids: *Entolasia stricta*, ***Austrostipa pubescens***, *Chionochloa pallida*, *Caustis flexuosa*, ***Cyathochaeta diandra***, *Lomandra longifolia*, ***Lomandra obliqua***, ***Lomandra glauca***, ***Xanthorrhoea media***.

Ground layer-ferns & herbs: *Pteridium esculentum*, *Dianella caerulea*, ***Dampiera stricta***, ***Actinotus minor***, *Tetratheca ericifolia*, *Dipodium variegatum*, *Centella asiatica*.

Climbers: *Hardenbergia violacea*, ***Cassytha*** species, ***Billardiera scandens***, *Smilax glycyphylla*.

Threat level: Part of the Duffys Forest community.

Examples: Main occurrence in St. Ives district e.g. below bike track at St. Ives Showground (Figures 10a and 10b), HART site, Surgeon White Reserve.

Notes: Analysis of plot data using the Smith DF Index indicates that transitional zone at the showground, at least, has a greater affinity to DF than SSRW. Floristically it is very similar to CSSF (low forest-woodland form). Transition to gully forest can also occur (mesic form of transition) on sheltered slopes with gully influence e.g. at St. Ives Showground. Typical species include: *Eucalyptus sieberi*, *Angophora costata*, *Eucalyptus globoidea*, *Ceratopetalum gummiferum*, *Pittosporum undulatum*, *Leptospermum polygalifolium*, *Callistemon citrinus*, *Epacris pulchella*, *Cyathea australis*.

The DF transitional form could be included in CSSF, however, due to the very narrow zone, low representation of shale species (<20% within 20 m x 20 m plot), and a similar number of DF diagnostic species to the typical form, it is considered more appropriate to retain as DF Transition.

Mapping: Some areas may be mapped within the broader classification of Duffys Forest (*complex*). DF (*transition form*) may occur below mapped DF (*complex* and *forms*) and further site-specific field investigation of boundaries is recommended.



Figure 10a Duffys Forest (*transition form*), condition A
St. Ives Showground



Figure 10b Duffys Forest (*transition form*), condition TXUD
St. Ives Showground

SYDNEY SANDSTONE RIDGETOP WOODLAND (INCLUDING HEATH OR SHRUB DOMINATED VEGETATION)

Sydney Sandstone Ridgetop Woodland **SSRW**

Hornsby Sandstone Exposed Bloodwood Woodland (S_DSF11)
Hornsby Sandstone Heath-Woodland (S_DSF12)

Sydney Sandstone Ridgetop Woodland (clay influence) **SRWCL**

Hornsby Enriched Sandstone Exposed Woodland (S_DSF10)

Sydney Sandstone Ridgetop Woodland (wet heath) **SSRWH**

Coastal Upland Damp Heath Swamp (S_FRW01)



Description

Sydney Sandstone Ridgetop Woodland (SSRW) is a variable low forest or woodland vegetation type occurring extensively on ridgetops and exposed slopes on Sydney sandstone. SSRW is floristically similar to both Duffys Forest and Coastal Shale Sandstone Forest (*low forest – woodland form*). It is distinguished from these similar communities on the basis of a very high sandstone influence (including rock outcrops) and a high proportion of typical or diagnostic SSRW species and low proportion of indicative shale species.

Detailed survey within this community across Ku-ring-gai has been limited to-date and mapping is largely based on DECCW (2009a).

DECCW (2009a) identifies three woodland and two heath communities within the Ku-ring-gai LGA (outlined above). More intensive survey within the Hawkesbury-Nepean Catchment Management Area, may identify additional communities within this vegetation type.

SSRW within Ku-ring-gai is dominated by Red Bloodwood *Corymbia gummifera*, Smooth-barked Apple *Angophora costata*, Scribbly Gums (*Eucalyptus haemastoma*, *E. racemosa*), Sydney Peppermint *E. piperita*, Silvertop Ash *Eucalyptus sieberi* and Stringybarks (*Eucalyptus capitellata*, *E. oblonga*, *E. sparsifolia*). The understorey is shrubby, diverse and species-rich.

SSRW vegetation has been split into numerous communities within the Sydney Metropolitan CMA Area. New communities within this sandstone vegetation may also be identified within the Hawkesbury Nepean CMA of the LGA

Threats

Threats are considerably lower than on shale geologies, however, the usefulness of flatter ridgelines for residential development and access (road, tracks) provides for a moderate threat level, particularly at the edge of existing urban areas. Communities occurring in such habitats often contain a high number of threatened flora species including *Darwinia biflora*, *Melaleuca deanei*, *Tetratheca glandulosa*, *Persoonia hirsuta* and *Eucalyptus camfieldii*.

Conservation Status

Regionally significant due to habitat for threatened species and moderate threat levels. Probably adequately reserved.

Table 16: Conservation status of SSRW within Ku-ring-gai

	Vegetation community	Area within Ku-ring-gai (ha) (excluding DECCW lands)				
		A / B	TXND / TXN	TXUD / TXU	CMI / R	TOTAL
Council natural area						
TOTAL						
Other council managed lands						
TOTAL						
Other lands (excluding DECCW estate)						
TOTAL						
Total extant area						

* To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)

Relationship to Other Communities

* To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)

Relationship to Other Mapping

Sydney Sandstone Ridgetop Woodland fits within the:

- statewide class *Sydney Coastal Dry Sclerophyll Forests*, unique to the Greater Sydney region (Keith 2004)
- Relationship to PVP biometric vegetation (DECCW 2009), Sydney Metropolitan Catchment Management Authority Area mapping (DECCW 2009a) and regional SCIVI mapping (Tozer *et al* 2006).
- * To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)

Species Richness

* To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)

Hornsby Sandstone Exposed Bloodwood Woodland (S_DSF11)

** To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)*

Hornsby Sandstone Heath-Woodland (S_DSF12)

** To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)*

Hornsby Enriched Sandstone Exposed Woodland (S_DSF10)

** To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)*

Coastal Upland Damp Heath Swamp (S_FrW01)

** To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)*

SYDNEY SANDSTONE GULLY FOREST

Sydney Sandstone Gully Forest **SSGF**

Coastal Enriched Sandstone Sheltered Forest (S_DSF04)
Coastal Sandstone Riparian Forest (S_DSF08)
Coastal Sandstone Sheltered Peppermint Apple Forest (S_DSF09)

Sydney Sandstone Gully Forest (*clay influence*) **SSGFCL**

Coastal Enriched Sandstone Moist Forest (S_WSF02)



Description

Sydney Sandstone Gully Forest (SSGF) is a variable forest vegetation type occurring extensively along gullies on Sydney sandstone. SSGF can be floristically similar to Coast Shale Sandstone Forest and transitional forms of Sydney Turpentine-Ironbark Forest. It is distinguished from these similar communities on the basis of a higher sandstone influence (including more extensive rock outcrops) and a high proportion of typical sandstone species relative to indicative shale species.

Detailed survey within this community across Ku-ring-gai has been limited to-date and mapping is largely based on DECCW (2009a).

DECCW (2009a) identifies four SSGF communities within the Ku-ring-gai LGA (as outlined above).

The most widespread and common community is *Coastal Enriched Sandstone Sheltered Forest*, a tall eucalypt forest with a sparse smaller tree layer above an understorey of dry sclerophyll shrubs, ferns & herbs. This is a drier forest typically with extensive rock outcrops. Within Ku-ring-gai it is found along the larger, deeper sandstone gullies associated with the Lane Cove River to the south and Middle Harbour catchment to the east.

The second community, *Coastal Enriched Sandstone Moist Forest*, has a more restricted distribution within Ku-ring-gai associated with deeper gullies of the higher slopes although regionally it is found between Lane Cove and Baulkham Hills, and extending to the fringes of the Cumberland Plain. This community has a distinct shale influence. It is a tall forest with a mesic understorey including a fern dominated ground layer and often a rainforest element.

SSGF vegetation has been split into numerous communities within the Sydney Metropolitan CMA Area. New communities within this gully forest vegetation may also be identified within the Hawkesbury Nepean CMA of the LGA

Threats

Direct threats are considerably lower than on shale geologies. The *Coastal Enriched Sandstone Moist Forest* and associated rainforest communities are the most threatened due to their location closer to urban areas and their more fertile soils. The intensive development that has occurred (and continues) along the ridgelines and upper slopes, however, has serious indirect impacts on gully forest down-slope with nutrient enrichment and weed invasion major threats to long-term diversity and integrity of these communities.

Conservation Status

Regionally significant particularly those forests with shale influence in transitional areas which are unlikely to be adequately reserved.

Table 17: Conservation status of SSGF within Ku-ring-gai

	Vegetation community	Area within Ku-ring-gai (ha) (excluding DECCW lands)				
		A / B	TXND / TXN	TXUD / TXU	CMI / R	TOTAL
Council natural area						
TOTAL						
Other council managed lands						
TOTAL						
Other lands (excluding DECCW estate)						
TOTAL						
Total extant area						

** To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)*

Relationship to Other Communities

** To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)*

Relationship to Other Mapping

Sydney Sandstone Gully Forest fits within the:

- The drier communities within SSGF e.g. Coastal Enriched Sandstone Sheltered Forest belongs to the statewide class *Sydney Coastal Dry Sclerophyll Forests* but the Coastal Enriched Sandstone Moist Forest belongs to the North Coast Wet Sclerophyll Forests class. (Keith 2004).
- Relationship to PVP biometric vegetation (DECCW 2009), Sydney Metropolitan Catchment Management Authority Area mapping (DECCW 2009a) and regional SCIVI mapping (Tozer *et al* 2006).
- ** To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)*

Species Richness

** To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)*

Coastal Enriched Sandstone Sheltered Forest (S_DSF04)

Geology: Sandstone environment (Hawkesbury, Gymea).

Altitude: Widespread on Hornsby Plateau at elevations less than 200 m and where rainfall is >1000 mm.

Soil landscape & characteristics: Hawkesbury & Gymea soil landscapes. Sandy soils with extensive sandstone outcrop.

Habitat: Predominantly sheltered slopes but also ridgetops or other gentle gradients where soil is deep enough.

Vegetation structure & composition: Tall open forest with understorey of dry sclerophyll shrubs with ferns and herbs amongst groundcover. Species recorded in Ku-ring-gai are listed below (based on limited survey).

Canopy trees: *Corymbia gummifera* (D), *Angophora costata* (D), *Eucalyptus piperita* (D), *Eucalyptus pilularis*.

Smaller trees: *Allocasuarina littoralis*, *Banksia serrata*, *Elaeocarpus reticulatus*, *Pittosporum undulatum*, *Ceratopetalum gummiferum*, *Leptospermum trinervium*, *Persoonia levis*.

Shrubs: *Acacia suaveolens*, *Acacia ulicifolia*, *Acacia terminalis*, *Dodonaea triquetra*, *Lomatia silaifolia*, *Banksia spinulosa*, *Grevillea linearifolia*, *Pimelea linifolia*, *Platysace linearifolia*.

Ground layer: *Entolasia stricta*, *Pteridium esculentum*, *Lomandra obliqua*, *Lomandra longifolia*, *Xanthorrhoea arborea*, *Dianella caerulea*, *Phyllanthus hirtellus*, *Gonocarpus teucrioides*, *Xanthosia pilosa*, *Lepidosperma laterale*.

Examples: Examples include sandstone gullies in the vicinity of Acron Oval, East Killara, West Pymble and South Turrumurra. Known to extend beyond the SMCMA into the hinterland of the Central Coast and west to the footslopes of the northern Blue Mountains.

Notes: Probably adequately protected in Lane Cove and Garigal National Parks.

Coastal Enriched Sandstone Moist Forest (S_WSF02)

Geology: Sandstone environment (GyMEA, Hawkesbury); some clay influence from residual shale capping on ridgelines above.

Altitude: At elevations mostly 110 - 140 m within Ku-ring-gai.

Soil landscape & characteristics: GyMEA & Hawkesbury soil landscapes. Sandy soils with extensive sandstone outcrop but some shale enrichment.

Habitat: Deep protected sandstone gorges.

Vegetation structure & composition: Tall open forest with understorey of moist open shrub layer and dominant cover of ferns and climbers on the forest floor. Species recorded in Ku-ring-gai are listed below (based on limited survey).

Canopy trees: *Eucalyptus pilularis*, *Angophora costata*, *Syncarpia glomulifera*, *Eucalyptus saligna*, *Angophora floribunda*.

Smaller trees: *Allocasuarina torulosa*, *Pittosporum undulatum*, *Ceratopetalum apetalum*, *Glochidion ferdinandi*.

Shrubs: *Notelaea longifolia*, *Astrotricha floccosa*, *Synoum glandulosum*, *Elaeocarpus reticulatus*.

Ground layer: *Entolasia stricta*, *Calochlaena dubia*, *Blechnum cartilagineum*, *Hypolepis muelleri*, *Sticherus flabellatus*, *Lomandra longifolia*, *Poa affinis*, *Oplismenus imbecillus*, *Smilax glyciphylla*.

Examples: Examples include deep sandstone gullies at Sheldon Forest (Pymble), South of Denman Street (Turramurra) and in the Wahroonga district e.g. in the vicinity of the Sydney Adventist Hospital. Known to occur beyond the SMCMA on the fringes of the Cumberland Plain.

Notes: Poorly documented within Ku-ring-gai, field investigation required. Probably inadequately protected in national parks.

Coastal Sandstone Sheltered Peppermint Apple Forest (S_DSF09)

* To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)

Coastal Sandstone Riparian Forest (S_DSF08)

* To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)

Gully Rainforest

GRF

Coastal Warm Temperate-Dry Rainforest (S_RF04)

Coastal Sandstone Gallery Rainforest (S_RF02)



Description

Additional description to be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)

At one known site, Browns Field (Campbell Drive, Wahroonga), rainforest species are more diverse and form a more intact rainforest structure. This patch has been identified by DECCW (2009a) as an example of *Coastal Warm Temperate-Dry Rainforest*.

Threats

* To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)

Conservation Status

Coastal Warm Temperate-Dry Rainforest is rare in the region and two locations have been mapped within the SMCMA.

Table 18: Conservation status of Gully Rainforest (*Coastal Warm Temperate-Dry Rainforest*) within Ku-ring-gai

	Vegetation community	Area within Ku-ring-gai (ha) (excluding DECCW lands)				
		A / B	TXND / TXN	TXUD / TXU	CMI / R	TOTAL
Council natural area	Gully Rainforest	1.64	-	-	-	1.64
	TOTAL	1.64	-	-	-	1.64
Other council managed lands	Gully Rainforest	0.35		-	-	0.35
	TOTAL	0.35		-	-	0.35
Other lands (excluding DECCW estate)	Gully Rainforest	0.18	1.89	-	-	2.08
	TOTAL	0.18	1.89	-	-	2.08
Total extant area		2.17	1.89	-	-	4.07

Coastal Warm Temperate-Dry Rainforest (S_RF04)

** To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)*

Coastal Sandstone Gallery Rainforest (S_RF02)

** To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)*

SALINE WETLANDS

Saline Wetlands

- Estuarine Mangrove Forest (S_SW01)
- Estuarine Saltmarsh (S_SW02)
- Seagrass Meadows (S_SW03)



Description

* To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)

Threats

* To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)

Conservation Status

Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions is listed as an Endangered Ecological Community under the NSW *Threatened Species Conservation Act 1995* (TSC Act).

Seagrass Meadows are protected under the NSW Fisheries Act, 1994.

Table 19: Conservation status of Saline Wetlands within Ku-ring-gai

	Vegetation community	Area within Ku-ring-gai (ha) (excluding DECCW lands)				
		A / B	TXND / TXN	TXUD / TXU	CMI / R	TOTAL
Council natural area	* To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)					
TOTAL						
Other council managed lands						
TOTAL						
Other lands (excluding DECCW estate)						
TOTAL						
Total extant area						

Seagrass Meadows (S_SW03)

** To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)*

Estuarine Mangrove Forest (S_SW01)

** To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)*

Estuarine Saltmarsh (S_SW02)

** To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)*

Forested Wetlands

Coastal Flats Swamp Mahogany Forest (S_FoW02)
Estuarine Swamp Oak Forest (S_FoW08)



Description

** To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)*

Threats

** To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)*

Conservation Status

Coastal Flats Swamp Mahogany Forest is a component of Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions and is listed as an Endangered Ecological Community under Schedule 1 of under the NSW *Threatened Species Conservation Act 1995* (TSC Act).

Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions, is listed as an Endangered Ecological Community under Schedule 1 of under the NSW *Threatened Species Conservation Act 1995* (TSC Act)..

Table 20: Conservation status of Forested Wetlands within Ku-ring-gai

Vegetation community	Area within Ku-ring-gai (ha) (excluding DECCW lands)				
	A / B	TXND / TXN	TXUD / TXU	CMI / R	TOTAL
Council natural area	<i>* To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)</i>				
TOTAL					
Other council managed lands					
TOTAL					
Other lands (excluding DECCW estate)					
TOTAL					
Total extant area					

Coastal Flats Swamp Mahogany Forest (S_FoW02)

** To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)*

Estuarine Swamp Oak Forest (S_FoW08)

** To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)*

2 Key to the identification of ecological communities in Ku-ring-gai LGA

1. Undulating topography at higher elevations with predominantly clay soils (any sandstone influence minor and related to sandstone laminae within shale or close to a creek-line); gullies absent or head gullies associated with higher ridges; dominant canopy species Blue Gum and Blackbutt, occasionally Turpentine.

Key 1 - Shale Forest Association (dominant soil landscapes: Glenorie, West Pennant Hills)

- 1* Slopes, secondary ridges/crests and gullies at lower elevations; soils with a higher sandstone influence; range of eucalypts or Turpentine dominant in canopy, and higher frequency of Smooth-barked Apple.
2. Transitional soils with distinct clay and sandy components, approaching the shale-sandstone boundary or close to gullies, rock outcrop minor to moderate and localised; indicative shale species present.

Key 2 – Transition Association (dominant soil landscapes: Lucas Heights, Gymea)

- 2* Predominant sandy soils located within a sandstone environment, often with extensive rock outcrop or conspicuous ironstone gravels; few shale species present although a localized clay influence may be evident.

Key 3 – Sandstone Association (dominant soil landscapes: Gymea, Hawkesbury)

Key 4 – Forest and Saline Wetland Association (Hawkesbury, Mangrove Creek)

The following communities are to be added to the Forest and Saline Wetland Association key upon completion of the Sydney Metropolitan Catchment Management Authority mapping (DECCW, 2009a):

Estuarine Mangrove Forest
Estuarine Saltmarsh
Seagrass Meadows

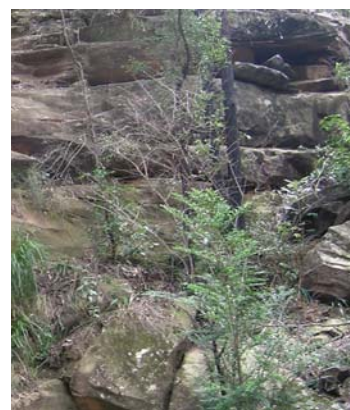
Coastal Flats Swamp Mahogany Forest
Estuarine Swamp Oak Forest



Shale soil profile



Transitional soil profile



Sandstone

Key 1 - Shale Forest Association

1. Undulating topography at higher elevations with predominantly clay soils (presence of sand from localized sandstone laminae within shale rather than sandstone bedrock), generally away from incised creek- lines and sandstone species absent or rare.
2. Sheltered slopes, wetter local conditions; canopy dominated by Sydney Blue Gum & Blackbutt1a. *BGHF (typical form)*
- 2* More exposed sites with drier local conditions; higher diversity of canopy trees including Grey Ironbark, White Stringybark, Sydney Blue Gum , Blackbutt, and/or Turpentine.
3. Sydney Blue Gum locally common with Blackbutt; primary or secondary ridgelines, spurs or upper slopes 1b. *BGHF (dry form)*
- 3* Blackbutt or Turpentine locally common, Sydney Blue Gum occasional to rare; upper to mid-slope or secondary ridges closer to shale/sandstone boundary..... 2a. *STIF (typical form)*
- 1* Slopes associated with head gullies below higher ridgelines; soils with some sandstone influence close to creek; canopy dominated by Sydney Blue Gum & Blackbutt; some sandstone species usually present e.g. Christmas Bush, Cedar Wattle, Lillypilly, Blueberry Ash1c. *BGHF (sandstone gully form)*

Key to vegetation communities

BGHF = Blue Gum High Forest

STIF = Sydney Turpentine-Ironbark Forest

Key to tree species

Sydney Blue Gum = *Eucalyptus saligna*

Blackbutt = *Eucalyptus pilularis*

Turpentine = *Syncarpia glomulifera*

Red Mahogany = *Eucalyptus resinifera*

Grey Ironbark = *Eucalyptus paniculata*

White Stringybark = *Eucalyptus globoidea*

Christmas Bush = *Ceratopetalum gummiferum*

Cedar Wattle = *Acacia elata*

Lillypilly = *Acmena smithii*

Blueberry Ash = *Elaeocarpus reticulatus*

Key 2 – Transition Association

1. Slopes or flatter areas in higher parts of the landscape (i.e. away from main sandstone environment) with low sandstone influence (generally just below typical STIF or BGHF); relatively deep sandy clay loams with no or localised sandstone outcrop but sandstone fragments and ironstone gravels may be present; shale species well represented.
 2. Wetter sites (e.g. sheltered slopes); taller canopy trees include Sydney Blue Gum, Blackbutt, Turpentine & Smooth-barked Apple as more frequent species; understorey with a distinct mesic influence i.e. good representation of broader, soft-leaved species.
 3. Deeper soils along poorly defined creeks at higher elevations; Sydney Blue Gum a dominant canopy species1c. *BGHF (sandstone gully form)*
 - 3* Medium to shallow soils on lower slopes or above creeks in close proximity to the shale/sandstone boundary; Blackbutt and Turpentine are dominant canopy species.....2b. *STIF (wet transition form)*
 - 2* Drier sites e.g. exposed gentle slopes, benches or crests; shorter canopy trees include Smooth-barked Apple, Red Mahogany & White Stringybark as more frequent species; understorey drier with higher representation of drier species.....2c. *STIF (dry transition form)*

- 1* Slopes or plateaus/ridges/crests with higher sandstone influence, rock often outcropping; location close to or within the sandstone environment, sandstone species common but shale species still present.
 4. Taller forest with Blackbutt and Smooth-barked Apple locally common; lateritic gravels not conspicuous.
 5. Mid gentle to moderate slopes with occasional outcrops above steeper gully; drier understorey with scattered shrubs and a grassy ground cover; both sandstone and shale species present3a. *CSSF (taller forest form)*
 - 5* Lower slopes close to creek-line, often rocky; mesic understorey typically with dense shrub layer and dominant fern cover; sandstone species dominant 4. *Sydney Sandstone Gully Forest (see Sandstone Association)*
 - 4* Low forest or woodland with range of canopy species; conspicuous ironstone gravels often present.
 6. Soils relatively shallow, clay evident often with ironstone gravels but sandstone outcrops and/or fragments often present; Scribbly Gum typically a dominant canopy tree; both shale and sandstone species typically present in understorey.
 7. Site close to the sandstone end of distinct shale to sandstone transition (i.e. good connectivity with shale soils supporting STIF or BGHF).
 8. Understorey with moderate to dense shrub layer and higher proportion of SSRW species e.g. *Acacia suaveolens*, *Acacia longifolia*, *Banksia serrata*, *Hakea teretifolia*;

Stringybarks present typically *Eucalyptus oblonga* & *Eucalyptus sparsifolia*; sandstone end of transition
....5. SSRW (*clay influence*) (see Sandstone Association)

- 8* Understorey with a more grassy ground cover & greater shale species component e.g. *Dichondra repens*, *Microlaena stipoides*, *Glycine microphylla*, *Eragrostis brownii*; Stringybarks present likely to include *Eucalyptus resinifera* or *Eucalyptus globoidea*; medium to high sandstone influence
...3b. CSSF (*low forest/woodland form*)
- 7* Site generally below DF (typical form) & within or close to a more extensive sandstone environment; limited connectivity with shale soils (can include small patches of Glenorie)
.... 6b. DF (*transition form*)
- 6* Soils typically deeper with conspicuous red ironstone gravels, sandstone outcrops rare; Brown Stringybark often present with Scribbly Gum less common; sandstone species dominant6a. DF (*typical form*)

Key to communities

BGHF – Blue Gum High Forest
STIF – Sydney Turpentine-Ironbark Forest
TIMF – Turpentine-Ironbark Margin Forest
DF – Duffys Forest

Key to tree species

Blackbutt - *Eucalyptus pilularis*
Red Bloodwood - *Corymbia gummifera*
Scribbly Gum – *Eucalyptus haemastoma*
Sydney Blue Gum *Eucalyptus saligna*
White Stringybark – *Eucalyptus globoidea*

Brown Stringybark – *Eucalyptus capitellata*
Red Mahogany – *Eucalyptus resinifera*
Smooth-barked Apple – *Angophora costata*
Turpentine *Syncarpia glomulifera*

Key 3 – Sandstone Association

1. Tall forest vegetation of sandstone gullies and slopes, occasionally on sheltered ridgetops.
 2. Open eucalypt tree canopy with open to dense understorey of moisture-loving and/or dry sclerophyllous species.
 3. Moist sandstone gullies in higher rainfall areas on richer soils (shale influence); understorey typically with rainforest species and ferns; dominant canopy trees of Smooth-barked Apple, Blackbutt and Turpentine; mostly known from southern edge of LGA along Lane Cove River but probably more common.....1. *Coastal Enriched Sandstone Moist Forest*
 - 3* Sandstone gullies with drier aspects and more extensive outcropping of sandstone (lower rainfall areas, poorer soils); understorey typically drier but mesic elements also present; dominant canopy trees of Smooth-barked Apple and Sydney Peppermint but range of eucalypt species commonly found; extensive in sandstone gullies in the LGA and adjoining LGAs2. *Coastal Sandstone Sheltered Peppermint-Apple Forest*
 - 2* Low, dense tree canopy of rainforest species (taller emergents may be present).
 4. Gullies higher in landscape with stronger shale influence; rainforest species include *Cryptocarya*, *Guioa*, *Synoum* & *Livistona* as well as more typical sandstone species 3. *Coastal Warm Temperate-Dry Rainforest*
 - 4* Deeper gullies within stronger sandstone environment; rainforest species more typical of sandstone e.g. *Coachwood*, *Cedar Wattle*, *Black Wattle*, *Water Gum*.....4. *Coastal Sandstone Gallery Rainforest*
- 1* Woodland, low forest or heath-land on sandstone ridgetops and more exposed upper slopes with or without clay influence
 5. Scattered trees with extensive open areas of low heath vegetation 5...includes *Hornsby Sandstone Heath-Woodland* – Garigal Park
 - 5* Denser tree cover as dominant vegetation cover
 6. Soils relatively deep with conspicuous red ironstone gravels and red clay soils, sandstone outcrops rare; understorey with scattered shrubs and grassy component; Brown Stringybark and Silver-top Ash often common tree species.....7. *Duffys Forest*
 - 6* Soils typically shallow, red clay and ironstone gravels may be present but rarely conspicuous, sandstone outcrops or fragments common; understorey often with dense shrub layer; Scribbly Gum and Sydney Peppermint often common tree species.
 7. Dominant canopy species of Scribbly Gum and Sydney Peppermint; taller woody shrub layer of Black She-oak and Dwarf Apple; lower rainfall areas within headwaters of the Lane Cove Valley and Pennant Hills Park8. *Hornsby Enriched Sandstone Exposed Woodland*

Key to tree & shrub species

Brown Stringybark – *Eucalyptus capitellata*
Black She-oak – *Allocasuarina littoralis*
Red Bloodwood - *Corymbia gummifera*
Dwarf Apple – *Angophora hispida*
Scribbly Gum – *Eucalyptus haemastoma*
Smooth-barked Apple – *Angophora costata*
Flaky-barked Tea-tree – *Leptospermum trinervium*
Heath Banksia – *Banksia ericifolia*

The following communities are to be added to the sandstone associations' key upon completion of the Sydney Metropolitan Catchment Management Authority mapping (DECCW, 2009a):

Coastal Enriched Sandstone Sheltered Forest
Coastal Sandstone Riparian Forest
Coastal Upland Damp Heath Swamp
Hornsby Sandstone Exposed Bloodwood Woodland
Coastal Sandstone Plateau Rock Plate Heath

Key 4 – Forest and Saline Wetland Association

** To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)*

3 Ku-ring-gai LGA – vegetation communities and relationships with geology, soils and landscape features

Primary references use in the creation of table below: DEC (2003), NSW Final Determinations (NSW SC 1998, NSW SC 1998a, NSW SC 2007), Benson & Howell (1994), Smith & Smith (2007), DECCW (2009a).

Key to communities

BGHF= Blue Gum High Forest

DF= Duffys Forest

SSRW= Sydney Sandstone Ridgetop Woodland

STIF= Sydney Turpentine-Ironbark Forest

CSSF= Coastal Shale Sandstone Forest

SSGF= Sydney Sandstone Gully Forest

Key to species frequency

D = dominant

C = common

O = occasional

R = rare

E = emergent

Notes - difficulties in identification of communities

1. Close to the shale/sandstone boundary there is a high diversity of geologies, soil types & topographical elements within a relatively small area. As a consequence:
 - Communities may be highly localised and restricted in area e.g. BGHF in depressions, CSSF in narrow zones depending on steepness of slope & exposure of sandstone
 - Transitional elements are likely to be common (may be the norm rather than the exception)
 - Main drivers of vegetation within local area – degree of slope, degree of sandstone influence & depth of soil, altitude, topography & aspect, disturbance history).
2. The absence of intact native understorey in many remnants and widespread occurrence of canopy species across a range of topographical units and communities e.g. Blackbutt and Turpentine give rise to a lack of useful indicator species.

It is similar for groundcover species. Suite of species common to most communities on shale – *Dichondra repens*, *Oplismenus aemulus*, *Cyperus gracilis*, *Veronica plebeia*, *Carex inversa*, *Rumex brownii*, *Microlaena stipoides*, *Dianella caerulea*.

3. It is important to look holistically at the general landscape units, localized topographical variability, soils and proximity to drainage lines or creeks. Suggestions:
 - familiarize yourself with topography, soil landscapes & drainage patterns prior to field inspection
 - begin with a transect e.g. from ridge to drainage line to establish vegetation patterns
 - check soil depth and sand/clay content – roadside cuttings useful.

Vegetation Community		Geology	Landscape & altitude (asl)	Soil landscape	Soil characteristics	Typical tree & shrub species	Vegetation structure & typical groundcover species
Blue Gum High Forest (complex)	BGHF (<i>typical form</i>)	Shale	Higher broad ridges & steep side slopes >20% –particularly south and east-facing; in shallow depressions or elevated drainage lines on upper-mid slopes; mostly 90 - 190 m.	<u>West Pennant Hills</u> <u>Glenorie</u> Lucas Hts	Deep dark brown to brown clay to clay loam.	<i>Eucalyptus saligna</i> D <i>Eucalyptus pilularis</i> D <i>Allocasuarina torulosa</i> <i>Pittosporum undulatum</i> <i>Breynia oblongifolia</i> <i>Polyscias sambucifolia</i> <i>Pittosporum revolutum</i> <i>Acmena smithii</i>	Tall open-forest with mesic understorey. <i>Calochlaena dubia</i> , <i>Adiantum aethiopicum</i> , <i>Geranium homeanum</i> , <i>Cyperus gracilis</i> , <i>Oplismenus aemulus</i> , <i>Entolasia marginata</i> , <i>Centella asiatica</i> , <i>Dichondra repens</i> , <i>Microlaena stipoides</i> , <i>Commelina cyanea</i> , <i>Eustrephus latifolius</i> , <i>Pseuderanthemum variabile</i>
	BGHF (<i>dry form</i>) *similar to STIF but <i>E. saligna</i> dominant locally	Shale (minor sandstone influence may be present).	Higher ridgelines, crests & benches or spurs, more exposed aspects. Mostly 130 - 200 m	<u>Glenorie</u> Lucas Hts	Medium depth brown to orange brown, silty to sandy clay loam, some ironstone gravels may be present.	<i>Eucalyptus saligna</i> C <i>Eucalyptus paniculata</i> C <i>Angophora floribunda</i> C <i>Eucalyptus pilularis</i> C <i>Angophora costata</i> C <i>Syncarpia glomulifera</i> O <i>Acacia implexa</i> <i>Pittosporum undulatum</i> <i>Leucopogon juniperinus</i> <i>Bursaria spinosa</i> <i>Dodonaea triquetra</i> <i>Indigofera australis</i>	Tall to medium open-forest with drier understorey. <i>Oplismenus aemulus</i> , <i>Cyperus gracilis</i> , <i>Echinopogon</i> species, <i>Dichondra repens</i> , <i>Veronica plebeia</i> , <i>Rumex brownii</i> , <i>Centella asiatica</i> , <i>Glycine microphylla</i> , <i>Austrodanthonia racemosa</i> , <i>Hardenbergia violacea</i> , <i>Lomandra longifolia</i> , <i>Pratia purpurascens</i> , <i>Microlaena stipoides</i>
	BGHF (<i>sandstone gully form</i>)	Shale with sandstone influence.	Lower to mid -slopes of shallow depressions or elevated gullies in higher parts of landscape. Mostly 80 -190 m	<u>Glenorie</u> , <u>Gynea</u> Lucas Hts	Sandy or silty clay loam, may contain sandstone fragments or minor outcropping.	<i>Eucalyptus saligna</i> D <i>Eucalyptus .pilularis</i> D <i>Angophora costata</i> C <i>Syncarpia glomulifera</i> C <i>Angophora floribunda</i> <i>Acacia elata</i> <i>Allocasuarina torulosa</i> <i>Tristaniopsis laurina</i> <i>Acmena smithii</i> <i>Ceratopetalum</i>	Tall open-forest with mesic understorey. Typical species: <i>Calochlaena dubia</i> , <i>Cyathea australis</i> , <i>Blechnum cartilagineum</i> , <i>Adiantum aethiopicum</i> , <i>Pteridium esculentum</i> , <i>Geranium homeanum</i> , <i>Entolasia marginata</i> , <i>Dianella caerulea</i> , <i>Microlaena stipoides</i> ,

Vegetation Community	Geology	Landscape & altitude (asl)	Soil landscape	Soil characteristics	Typical tree & shrub species	Vegetation structure & typical groundcover species	
					<i>gummiferum</i> <i>Breynia oblongifolia</i> <i>Polyscias sambucifolia</i> <i>Notelaea longifolia</i>	<i>Cyperus gracilis</i> , <i>Dichondra repens</i> , <i>Lomandra longifolia</i> , <i>Oplismenus aemulus</i> , <i>Eustrephus latifolius</i> , <i>Pseuderanthemum variabile</i> , <i>Viola hederacea</i> , <i>Siegesbeckia orientalis</i> , <i>Pandorea pandorana</i> , <i>Clematis glycinoides</i> , <i>Morinda jasminoides</i> .	
Sydney Turpentine-Ironbark Forest (complex)	STIF (typical form)	Shale (minor sandstone influence may be present).	Secondary ridges, lower plateaus & moderate to gentle slopes. Exposed or sheltered conditions. Mostly 70-180 m.	<u>Glenorie</u> Lucas Heights Gymea	Medium depth brown to orange-brown loam to clay loam – medium to high clay content; ironstone gravels & sandstone fragments may be present but local.	<i>Syncarpia glomulifera</i> , D <i>Eucalyptus pilularis</i> D <i>Eucalyptus paniculata</i> C <i>Angophora floribunda</i> C <i>Eucalyptus resinifera</i> <i>Angophora costata</i> <i>Eucalyptus saligna</i> <i>Elaeocarpus reticulatus</i> <i>Acacia implexa</i> <i>Acacia parramattensis</i> <i>Pittosporum undulatum</i> <i>Breynia oblongifolia</i> <i>Polyscias sambucifolia</i> <i>Leucopogon juniperinus</i> <i>Indigofera australis</i> <i>Ozothamnus diosmifolius</i>	Medium to tall open-forest with both mesic & drier, shrubby understorey. <i>Microlaena stipoides</i> , <i>Oplismenus aemulus</i> , <i>Veronica plebeia</i> , <i>Kennedia rubicunda</i> , <i>Glycine microphylla</i> , <i>Dichondra repens</i> . <i>Echinopogon species</i> , <i>Austrodanthonia racemosa</i> , <i>Themeda australis</i> , <i>Entolasia species</i> , <i>Cyperus gracilis</i> , <i>Desmodium varians</i> , <i>Geranium homeanum</i> , <i>Imperata cylindrica</i> var. <i>major</i> , <i>Pteridium esculentum</i> , <i>Dianella caerulea</i> , <i>Hardenbergia violacea</i>
	STIF (wet transition form)	Shale & transitional soils (Mittagong Formation).	Mid to lower sheltered slopes close to shale – sandstone boundary; often associated with sandstone gullies.	<u>Lucas Heights</u> Gymea Glenorie	Medium to shallow brown to orange – brown sandy clay loam, often with sandstone fragments or	<i>Syncarpia glomulifera</i> , D <i>Eucalyptus pilularis</i> D <i>Angophora costata</i> C <i>E. resinifera</i> C <i>Angophora floribunda</i> <i>Acacia elata</i> <i>Allocasuarina torulosa</i>	Medium to tall open-forest with mesic understorey. <i>Microlaena stipoides</i> , <i>Oplismenus aemulus</i> , <i>Dichondra repens</i> . <i>Echinopogon species</i> , <i>Entolasia species</i> , <i>Cyperus</i>

Vegetation Community	Geology	Landscape & altitude (asl)	Soil landscape	Soil characteristics	Typical tree & shrub species	Vegetation structure & typical groundcover species	
				minor outcrops	<i>Elaeocarpus reticulatus</i> <i>Pittosporum undulatum</i> <i>Breynia oblongifolia</i> <i>Polyscias sambucifolia</i> <i>Notelaea longifolia</i>	<i>gracilis</i> , <i>Geranium homeanum</i> , <i>Imperata cylindrica</i> var. <i>major</i> , <i>Pratia purpurascens</i> , <i>Pteridium esculentum</i> , <i>Calochlaena dubia</i> , <i>Cyathea australis</i> , <i>Blechnum cartilagineum</i> , <i>Dianella caerulea</i> , <i>Pseuderanthemum variabile</i> , <i>Eustrephus latifolius</i>	
	STIF (<i>dry transition form</i>)	Shale & transitional soils (Mittagong Formation).	Secondary crests, benches, spurs & gentle mid-slopes; relatively exposed conditions. Often short distance upslope of shale/sandstone boundary. Mostly 60-130 m but to 190 m in highest areas.	<u>Lucas Heights</u> Gynea Glenorie	Medium to shallow soils, yellow to orange or brown sandy clay loam; loose sandstone fragments & ironstone gravels typically present.	<i>Syncarpia glomulifera</i> D <i>Angophora costata</i> D <i>Eucalyptus resinifera</i> C <i>Eucalyptus pilularis</i> <i>Eucalyptus globoidea</i> <i>Angophora floribunda</i> <i>Corymbia gummifera</i> <i>Acacia implexa</i> <i>Acacia parramattensis</i> <i>Ozothamnus diosmifolius</i> <i>Leucopogon juniperinus</i> <i>Acacia longifolia</i>	Medium to low open-forest with drier, more shrubby understorey; <i>Microlaena stipoides</i> , <i>Oplismenus aemulus</i> , <i>Veronica plebeia</i> , <i>Glycine microphylla</i> , <i>Dichondra repens</i> . <i>Echinopogon</i> species, <i>Aristida vagans</i> , <i>Austrodanthonia racemosa</i> , <i>Themeda australis</i> , <i>Entolasia</i> species, <i>Cyperus gracilis</i> , <i>Desmodium varians</i> , <i>Imperata cylindrica</i> , <i>Pteridium esculentum</i> , <i>Hardenbergia violacea</i>
Coastal Shale Sandstone Forest (complex)	CSSF (<i>taller forest form</i>)	Shale with sandstone influence (sandstone fragments or minor to moderate rock outcrop).	Broader plateaus with shale cap & moderate mid to lower-slopes close to or at shale/sandstone boundary. Mostly down-slope of BGHF & STIF. Mostly 60 – 100 m in	<u>Lucas Heights</u> Gynea	Shallow sandy loam or sandy clay loam, sometimes with ironstone gravels.	<i>Angophora costata</i> D <i>Eucalyptus. pilularis</i> D <i>Eucalyptus resinifera</i> C <i>Eucalyptus globoidea</i> C <i>Syncarpia glomulifera</i> C <i>Eucalyptus punctata</i> R <i>Corymbia gummifera</i> C <i>Eucalyptus piperita</i> C <i>Allocasuarina littoralis</i> <i>Acacia parramattensis</i>	Open-forest with scattered shrubs & grassy groundcover. <i>Themeda australis</i> , <i>Aristida vagans</i> , <i>Hardenbergia violacea</i> <i>Poa affinis</i> , <i>Calochlaena dubia</i> , <i>Entolasia</i> species, <i>Microlaena stipoides</i> , <i>Austrodanthonia</i> species,

Vegetation Community	Geology	Landscape & altitude (asl)	Soil landscape	Soil characteristics	Typical tree & shrub species	Vegetation structure & typical groundcover species
		southern LGA, up to 170 m in north			<i>Pittosporum undulatum</i> <i>Elaeocarpus reticulatus</i> <i>Persoonia linearis</i> , <i>Hakea sericea</i> , <i>Leucopogon juniperinus</i> , <i>Kunzea ambigua</i> , <i>Dodonaea triquetra</i> , <i>Pultenaea flexilis</i> , <i>Hibbertia aspera</i> , <i>Persoonia species</i> , <i>Bursaria spinosa</i> .	<i>Echinopogon species</i> , <i>Imperata cylindrica</i> var. <i>major</i> , <i>Austrostipa</i> <i>pubescens</i> , <i>A. rudis</i> , <i>Cyperus</i> <i>gracilis</i> , <i>Lomandra species</i> , <i>Lepidosperma laterale</i> , <i>Brunoniella australis</i> , <i>Dichondra repens</i> , <i>Desmodium varians</i> , <i>Goodenia hederacea</i> , <i>Pratia</i> <i>purpurascens</i> , <i>Euchiton</i> <i>sphaericus</i> , <i>Hardenbergia</i> <i>violacea</i> , <i>Veronica plebeia</i> , <i>Glycine species</i>
CSSF (low forest/woodland form)	Shale with sandstone influence (sandstone fragments or minor to moderate rock outcrop).	Ridges, crests, benches, upper to mid slopes close to sandstone, exposed & sheltered aspects. Variable – 160-190 m in Wahroonga district; 100-130 m at S. Turramurra.	<u>Lucas Heights</u> Gymea	Shallow sandy loam or sandy clay loam, often with ironstone gravels.	<i>Eucalyptus haemastoma</i> D <i>Eucalyptus racemosa</i> C <i>Eucalyptus resinifera</i> C <i>Eucalyptus globoidea</i> C <i>Angophora costata</i> C <i>Corymbia gummifera</i> C <i>Eucalyptus sieberi</i> O <i>Eucalyptus piperita</i> O <i>Allocasuarina littoralis</i> <i>Acacia parramattensis</i> <i>Pittosporum undulatum</i> <i>Leptospermum trinervium</i> <i>Hakea sericea</i> , <i>Leucopogon juniperinus</i> , <i>Kunzea ambigua</i> , <i>Dodonaea triquetra</i> , <i>Acacia myrtifolia</i> , <i>Phyllanthus hirtellus</i> , <i>Bursaria spinosa</i> , <i>Banksia spinulosa</i> , <i>Micrantheum ericoides</i> ,	Open-forest with scattered shrubs & grassy groundcover. <i>Themeda australis.</i> , <i>Aristida vagans</i> , <i>Hardenbergia violacea</i> <i>Poa affinis</i> , <i>Entolasia species</i> , <i>Microlaena stipoides</i> , <i>Austrodanthonia species</i> , <i>Echinopogon species</i> , <i>Imperata cylindrica</i> var. <i>major</i> , <i>Austrostipa pubescens</i> , <i>A. rudis</i> , <i>Cyperus gracilis</i> , <i>Lomandra species</i> , <i>Lepidosperma laterale</i> , <i>Brunoniella australis</i> , <i>Dichondra repens</i> , <i>Desmodium varians</i> , <i>Goodenia hederacea</i> , <i>Hardenbergia violacea</i> , <i>Veronica plebeia</i> , <i>Glycine species</i> , <i>Pratia purpurascens</i> , <i>Actinotus</i>

Vegetation Community	Geology	Landscape & altitude (asl)	Soil landscape	Soil characteristics	Typical tree & shrub species	Vegetation structure & typical groundcover species	
					<i>Bossiaea obcordata</i>	<i>minor, Pomax umbellata</i>	
Duffys Forest (complex)	DF (typical form)	Clay mantle (Mittagong Formation) within predominantly Hawkesbury Sandstone environment; rock outcrop rare.	Ridgetops, plateaus & upper slopes, usually upslope of sandstone vegetation but can occur on a mid-slope or bench down-slope of SSRW.	<u>Lucas Heights</u> Gynea Hawkesbury	Clay loams mostly with distinctive ironstone gravels.	<i>Corymbia gummifera</i> D <i>Angophora costata</i> D <i>Eucalyptus capitellata</i> C <i>Eucalyptus sieberi</i> C <i>Eucalyptus haemastoma</i> <i>Eucalyptus globoidea</i> <i>Allocasuarina littoralis</i> <i>Banksia serrata</i> , <i>Banksia ericifolia</i> , <i>Banksia spinulosa</i> , <i>Persoonia levis</i> , <i>Acacia myrtifolia</i> , <i>Bossiaea obcordata</i> , <i>Hakea sericea</i> , <i>Lomatia silaifolia</i> ,	Low open-forest with scattered shrubs and grassy groundcover. <i>Pteridium esculentum</i> , <i>Lindsaea linearis</i> , <i>Lindsaea microphylla</i> , <i>Micranthemum ericoides</i> , <i>Phyllanthus hirtellus</i> , <i>Aristida vagans</i> , <i>Entolasia stricta</i> , <i>Austrostipa pubescens</i> , <i>Lomandra longifolia</i> , <i>Lomandra obliqua</i> , <i>Xanthorrhoea media</i> , <i>Cyathochaeta diandra</i> , <i>Austrodanthonia tenuior</i> , <i>Dianella caerulea</i> , <i>Dampiera stricta</i>
	DF (transition Form)	Clay mantle (Mittagong Formation) within predominantly Hawkesbury Sandstone environment; clay cap or lens; rock outcrop rare.	Mostly mid-slopes or edge of bench.	Somersby <u>Lucas Heights</u> Lambert Gynea Hawkesbury	Sandy to sandy clay loam, ironstone gravels may be present.	<i>Corymbia gummifera</i> D <i>Eucalyptus haemastoma</i> D <i>Angophora costata</i> D <i>Eucalyptus sieberi</i> <i>Eucalyptus oblonga</i> <i>Eucalyptus sparsifolia</i> <i>Eucalyptus capitellata</i> <i>Allocasuarina littoralis</i> <i>Acacia longifolia</i> , <i>Banksia serrata</i> , <i>B. ericifolia</i> <i>Leptospermum trinervium</i> , <i>Bossiaea obcordata</i> , <i>Hakea sericea</i> , <i>Lomatia silaifolia</i> , <i>Persoonia spp</i>	Low open-forest to woodland with denser shrub understorey. <i>Pteridium esculentum</i> , <i>Lindsaea linearis</i> , <i>Phyllanthus hirtellus</i> , <i>Entolasia stricta</i> , <i>Austrostipa pubescens</i> , <i>Lomandra longifolia</i> , <i>Lomandra obliqua</i> , <i>Lomandra glauca</i> , <i>Xanthorrhoea media</i> , <i>Cyathochaeta diandra</i> , <i>Dianella caerulea</i> , <i>Dampiera stricta</i> , <i>Actinotus minor</i> , <i>Caustis flexuosa</i>
SSRW		Hawkesbury Sandstone;	Ridgetops, plateaus & upper slopes	Hawkesbury Gynea	Sand to sandy loam	<i>Eucalyptus haemastoma</i> , D	Low open-woodland. Typical species: <i>Banksia spp.</i> , <i>Hakea</i>

Vegetation Community		Geology	Landscape & altitude (asl)	Soil landscape	Soil characteristics	Typical tree & shrub species	Vegetation structure & typical groundcover species
		rock outcropping, some lateritic gravels may be present		Lucas Heights		<i>E. racemosa</i> , <i>Allocasuarina littoralis</i> , <i>Corymbia gummifera</i> , <i>Angophora costata</i> , <i>Eucalyptus oblonga</i>	spp., <i>Leptospermum trinervium</i> , <i>Gompholobium grandiflorum</i> , <i>Petrophile pulchella</i> , <i>Actinotus minor</i> , <i>Patersonia sericea</i> , <i>Ptilothrix deusta</i>
<i>Aligns with SM CMA communities (DECCW 2009a)</i>	Hornsby Sandstone Exposed Bloodwood Woodland	<i>* To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)</i>					
	Hornsby Sandstone Heath Woodland						
SSRW (clay influence)							
<i>Aligns with SM CMA communities (DECCW 2009a)</i>	Hornsby Enriched Sandstone Exposed Woodland	<i>* To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)</i>					
SSRW (wet heath)							
<i>Aligns with SM CMA communities (DECCW 2009a)</i>	Coastal Upland Damp Heath Swamp	<i>* To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)</i>					
SSGF	Hawkesbury Sandstone; rock outcropping extensively.	Narrow incised gullies/creek lines & slopes >25%	Hawkesbury Gynea Lucas Heights	Shallow, yellow-orange sand to sandy loam.	<i>Angophora costata</i> D <i>Eucalyptus pilularis</i> D <i>Eucalyptus piperita</i> C <i>Eucalyptus saligna</i> <i>Syncarpia glomulifera</i> D <i>Acacia elata</i> <i>Callicoma serratifolia</i> <i>Tristaniopsis laurina</i> ,	Tall forest & patches of closed forest along creeks; mesic & ferny understorey e.g. <i>Cyathea australis</i> , <i>Smilax glycyphylla.</i> , <i>Calochlaena dubia</i> , <i>Blechnum cartilagineum</i> , <i>Pultenea flexilis</i> ,	

Vegetation Community		Geology	Landscape & altitude (asl)	Soil landscape	Soil characteristics	Typical tree & shrub species	Vegetation structure & typical groundcover species
						<i>Ceratopetalum</i> species.	<i>Leptospermum polygalifolium</i> ,
Aligns with SM CMA communities (DECCW 2009a)	Coastal Sandstone Riparian Forest	* To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)					
	Coastal Enriched Sandstone Sheltered Forest						
	Coastal Sandstone Sheltered Peppermint Apple Forest						
SSGF (clay influence)		Hawkesbury Sandstone; less rock outcrop than above, often lateritic gravels present	Ridgetops, plateaus & upper slopes	Hawkesbury Gymea Lucas Heights	Sandy clay loam	<i>Eucalyptus haemastoma</i> , <i>Corymbia gummifera</i> <i>Eucalyptus oblonga/globoidea</i> <i>Eucalyptus punctata</i> (rare)	Open-woodland. Typical species: <i>Ozothamnus diosmifolius</i> , <i>Kunzea ambigua</i> , <i>Leucopogon juniperinus</i> , <i>Acacia linifolia</i> , <i>Leptospermum trinervium</i> , <i>Banksia spinulosa</i> , <i>Themeda australis</i> , <i>Aristida vagans</i> , <i>Lomandra glauca</i> , <i>Micrantheum ericoides</i> , * <i>Darwinia biflora</i> (threatened species)
Aligns with SM CMA communities (DECCW 2009a)	Coastal Enriched Sandstone Moist Forest	Hawkesbury Sandstone, rock outcrop extensive.	Deep protected sandstone gullies.	Gymea Hawkesbury	Sandy loam (shale enrichment).	<i>Eucalyptus pilularis</i> D <i>Angophora costata</i> D <i>Syncarpia glomulifera</i> D <i>Eucalyptus saligna</i> O <i>Angophora floribunda</i> <i>Allocasuarina torulosa</i> <i>Pittosporum undulatum</i> <i>Ceratopetalum apetalum</i> <i>Glochidion ferdinandi</i> <i>Notelaea longifolia</i>	Tall open forest with mesic understorey & dominant fern ground layer. <i>Entolasia stricta</i> , <i>Smilax glycyphylla</i> , <i>Calochlaena dubia</i> , <i>Blechnum cartilagineum</i> , <i>Hypolepis muelleri</i> , <i>Sticherus flabellatus</i> , <i>Lomandra longifolia</i> , <i>Poa affinis</i> , <i>Oplismenus imbecillus</i>

Vegetation Community	Geology	Landscape & altitude (asl)	Soil landscape	Soil characteristics	Typical tree & shrub species	Vegetation structure & typical groundcover species
					<i>Elaeocarpus reticulatus</i> <i>Synoum glandulosum</i> <i>Astrotricha floccosa</i>	
Gully Rainforest	GRF					
<i>Aligns with SM CMA communities (DECCW 2009a)</i>	Coastal Warm Temperate - Dry Rainforest Coastal Sandstone Gallery Rainforest					<i>* To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)</i>
Saline Wetlands <i>Derived from SM CMA communities (DECCW 2009a)</i>	Estuarine Mangrove Forest (S_SW01) Estuarine Saltmarsh (S_SW02) Seagrass Meadows (S_SW03)					<i>* To be incorporated upon completion of the Sydney Metropolitan CMA mapping (DECCW, 2009a)</i>
Forested Wetlands <i>Derived from SM CMA communities (DECCW 2009a)</i>	Coastal Flats Swamp Mahogany Forest (S_FoW02) Estuarine Swamp Oak Forest (S_FoW08)					